MUNICIPALITY OF COLOMBO.

REPORTS

OF THE

MEDICAL OFFICER OF HEALTH,

CITY ANALYST,

AND MUNICIPAL BACTERIOLOGIST

FOR THE YEAR

1921.

REPORT OF THE MEDICAL OFFICER OF HEALTH FOR 1921.

CONTENTS.

Part I.—General.

1.—METEOROLOGY.

The monthly mean temperature during the year ranged from 78·6° during February to 83·8° during May, with a mean for the year of 81·3°, as against the average of 80·8°.

The *rainfall* ranged from 0·19 inches during February to 8·97 inches during April, with a total for the year of only 53·56 inches, as against the average annual rainfall of 78·91 inches. This great shortage of rainfall during 1921 had a serious effect upon the sanitary condition of the town. Much of the town being low-lying and flat, the gradients of the drains are for the most part very low, and the normal heavy rainfall is necessary for their proper flushing and cleansing. In the absence of such flushing the soil in the bottom of the numerous unbuilt sewage-carrying drains becomes very foul and gives off offensive odours ; the contents of catchpits and gullies stagnate and breed enormous numbers of mosquitoes ; the swamps dry up, leaving mosquito-breeding pools ; and the canals become stagnant and foul and breed enormous numbers of mosquito larvæ ; all of which occurred during the year, and caused much complaint. Perhaps, the most serious consequence of this shortage of rain was the appearance of autochthonus, *i.e.*, locally acquired malaria, in the southern parts of the town, as the result apparently of the spread of malaria-bearing anopheles (*A. listoni* and (?) *A. sinensis*) from the rural areas to the south and east of the town, where they no doubt normally exist, but are usually kept in check by the periodic recurrence of floods.

(1) *Statistics.*

(Supplied by the Superintendent of the Observatory.)

(*a*) Average Monthly Mean Temperature at Colombo Observatory (Cinnamon Gardens). 14 Years.

	°
January	79·0
February	79·8
March	81·4
April	82·6
May	82·6
June	81·7
July	81·2
August	81·0
September	81·0
October	80·2
November	79·6
December	79·0
Year	80·8

(*b*) Monthly Mean Temperature at Colombo Observatory during 1921.

	°
January	79·8
February	78·6
March	80·9
April	81·7
May	83·8
June	83·0
July	82·0
August	81·2
September	82·4
October	80·8
November	80·6
December	80·5
Year	81·3

(*c*) Average Monthly Mean Pressure at Colombo Observatory (Cinnamon Gardens) (reduced to Standard Gravity and Mean Sea Level). 10 Years.

	Inches.
January	29·870
February	29·858
March	29·837
April	29·805
May	29·781
June	29·784
July	29·793
August	29·814
September	29·821
October	29·829
November	29·824
December	29·842
Year	29·822

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(*d*) Monthly Mean Pressure at Colombo Observatory during 1921 (reduced to Standard Gravity and Mean Sea Level).

	Inches.
January	29·842
February	29·844
March	29·813
April	29·818
May	29·770
June	29·769
July	29·785
August	29·809
September	29·849
October	29·821
November	29·883
December	29·839
Year	29·820

(*e*) Average Monthly Rainfall at Colombo Observatory (Cinnamon Gardens). 14 Years.

	Inches.
January	3·41
February	1·82
March	4·32
April	7·76
May	12·24
June	7·62
July	5·79
August	2·70
September	4·98
October	13·12
November	10·51
December	4·64
Year	78·91

(*f*) Monthly Rainfall at Colombo Observatory (Cinnamon Gardens) and Colombo Fort during 1921. (Observatory Gauge 25 Feet and Fort 70 Feet above Mean Sea Level.)

	Colombo Observatory. Inches.	Colombo Fort. Inches.
January	7·55	2·48
February	0·19	0·69
March	4·90	3·40
April	8·97	5·82
May	5·09	7·10
June	1·50	2·11
July	5·12	7·57
August	3·44	7·32
September	0·94	4·37
October	8·44	9·61
November	3·46	5·98
December	3·96	2·71
Year	53·56	59·16

(*g*) Average Monthly Mean Humidity at Colombo Observatory (Cinnamon Gardens). 13 Years.

	Per Cent.
January	76
February	76
March	78
April	79
May	81
June	81
July	80
August	80
September	79
October	82
November	82
December	79
Year	79

(*h*) Monthly Mean Humidity at Colombo Observatory during 1921.

	Per Cent.
January	78
February	75
March	80
April	82
May	79
June	78
July	77
August	80
September	75
October	82
November	76
December	75
Year	78

With reference to the rainfall at Fort, it should be noted that this gauge is not only higher above sea level, but higher above adjacent ground level, and for this its readings might be expected to be less than those of a gauge at or near ground level. The difference between it and the readings at the Observatory is thus not purely a climatic one, but largely a matter of the exposure of the two gauges.

The Observatory gauge should be taken as the standard.

The humidity in tables (*g*) and (*h*) is the mean of the humidities derived from the maximum both dry and wet, and the minimum dry and wet.

2.—Population.

The population of Colombo, as disclosed by the Census which was held on the night of March 18, 1921, was 244,163, as against the estimate for mid-year of 300,171 by the Registrar-General, and 285,895 by the Public Health Department, the actual intercensal increase being only 11 per cent., as against 33 per cent. during the previous intercensal period.

Colombo depends, to a large extent, for the increase of its population upon the influx of immigrants who come in search of employment ; thus, it is recorded in the 1911 Census report that only 19 per cent. of the population then enumerated were town-born, 81 per cent. being immigrants. From this it can be deduced that in the absence of any other cause, such as decimation by disease, which would be disclosed by the death-rate, or a progressive and very marked falling off of the natural increase, which would be disclosed by the birth-rate, a marked reduction in the rate of increase of the population must have been caused by a reduction in the excess of immigration over emigration.

An examination of the vital statistics shows that, although the death-rate rose during 1918 as the result of the influenza pandemic, only an insignificant part of the total loss of population disclosed by the Census was attributable to that cause. In like manner, an examination of the birth-rate shows that the loss is not attributable to a decline in the rate of natural increase. It may, therefore, confidently be asserted that the loss of population was mainly attributable to a reduction in the normal excess of immigration over emigration.

The chief cause of this reduction of immigration and consequent loss of population was apparently the economic depression which resulted from (*a*) the war, (*b*) the failure of the imported rice supplies, and (*c*) the slump in the rubber trade.

It is probable that the rate of increase of population was not materially affected until about 1917, and the death-rates have, consequently, been revised and raised only as far back as that year. It is also probable, and, in fact, as the birth-rate shows, it is almost certain that the population began to regain its lost ground in 1920. This recent increase of population would result not so much from an increase of the births *per se*, as from the influx of young adult immigrants, which may be deduced from the sudden great increase in the number of births recorded in the town. It is practically certain that a return of the economic conditions to normal will be accompanied by an influx of immigrants, and a consequent increase of the population, which in turn will cause the death-rates to appear fallaciously high.

(2) *Population.*

Race.	Population enumerated at the Census of March 18, 1921.
All Races	244,163
Europeans	2,836
Burghers	14,863
Sinhalese	114,600
Tamils]	54,153
Moors	39,692
Malays	5,852
Others	12,167

(3) *Area and Population by Wards, 1921.*

Ward.	Total Area in Acres.	Population at Census, 1921.	Density per Acre.
Fort	237 ..	2,690 ..	(10) 11·3
Pettah	129 ..	7,601 ..	(5) 58·8
San Sebastian ..	121 ..	11,492 ..	(2) 94·8
St. Paul's ..	157 ..	23,395 ..	(1) 118·6
Kotahena ..	1,716 ..	46,171 ..	(7) 26·9
New Bazaar ..	289 ..	23,341 ..	(3) 79·7
Maradana ..	1,773 ..	57,528 ..	(6) 32·5
Slave Island ..	322 ..	21,564 ..	(4) 66·7
Kollupitiya ..	1,465 ..	23,752 ..	(8) 16·2
Wellawatta ..	2,061 ..	26,629 ..	(9) 12·9
The Lake ..	317 ..	— ..	—
Colombo Town ...	8,587	244,163	28·4

Housing.—The following statement, the details of which were kindly furnished by the Works Engineer, shows the amount of land in Colombo which is available for building purposes :—

HOUSING PROBLEM.

(4) *Area available for Building Purposes.*

Ward.	Crown land available for Building.	Land without road Frontage.	Land under Flood Level.	Land available for building on immediately.
	A. R. P.	A. R. P.	A. R. P.	A. R. P.
Fort ..	3 2 21 ..	— ..	— ..	—
Pettah ..	17 0 7 ..	— ..	— ..	—
San Sebastian ..	2 0 34 ..	— ..	— ..	—
St. Paul's ..	— ..	3 2 20 ..	— ..	0 1 25
Kotahena ..	10 0 29 ..	26 0 27 ..	727 0 13 ..	60 3 35
New Bazaar ..	— ..	4 3 35 ..	72 0 0 ..	—
Maradana ..	13 3 11 ..	16 0 8 ..	926 0 0 ..	30 2 38
Slave Island ..	11 1 29 ..	— ..	— ..	6 0 34
Kollupitiya ..	26 1 10 ..	23 1 16 ..	60 0 0 ..	103 3 28
Wellawatta ..	46 3 36 ..	143 0 0 ..	382 0 0 ..	288 2 36
Total ..	131 2 17	217 0 26	2,167 0 13	490 3 36

3.—BIRTHS.

8,724 births were registered during the year, giving a rate of 35·7 per 1,000, as against the average of 24·7.

This remarkable increase in the birth-rate, which is depicted on the accompanying diagram, began during the fourth quarter of 1919, after a rather marked drop which occurred during the third quarter of that year, the drop being apparently attributable to the severe epidemic of influenza during the last quarter of the previous year. In this connection it is interesting to find that although the birth-rate of Colombo town recovered from the influenza epidemic almost immediately, and had already regained the normal within three months, the birth-rate of the Colombo District, which includes the adjacent rural areas, did not recover until more than a year later. This seems to indicate that the rural districts suffered more severely than the town from influenza, or that some other adverse factor, such as malaria perhaps, was operating in these rural areas.

The sudden great rise in the birth-rate during 1921 undoubtedly indicates the previous occurrence of a marked influx of young adult population, which in turn no doubt resulted from an improvement in the economic conditions. That such an improvement did actually occur, having in fact begun in 1919, is shown by the statistics of the Post Office Savings Bank, which were kindly placed at my disposal by Mr. Lovett, the Accountant of the General Post Office.

The rise in the birth-rate was most marked in the case of the Sinhalese, with an increase of no less than 16·4 per 1,000 compared with their average; the Malays came next with an increase of 11·7 compared with their average; Moors next with 7·7; then Burghers with 5·6; Tamils with 5·3; and Europeans with only 3·3. It seems probable that these figures represent fairly accurately the relative improvement in prosperity of the several races.

(5) *Births—Racial Birth-rates.*

Race.	Average Rate per 1,000 Population, 1911 to 1920.	Births, 1921.	Birth-rate per 1,000 Population, 1921.
All Races	24·7	8,724	35·7
Europeans	23·6	83	26·9
Burghers	34·0	578	39·6
Sinhalese	30·5	5,378	46·9
Tamils	13·9	1,056	19·2
Moors	21·3	1,160	29·0
Malays	39·3	301	51·1
Others	12·0	168	15·2

(6) *Ward Birth-rates.*

Ward.	Average Rate per 1,000 Population, 1911 to 1920.	Births, 1921.	Birth-rate per 1,000 Population 1921.
Colombo	24·7	8,724	35·7
Fort	3·2	4	1·5
Pettah	5·1	32	4·2
San Sebastian	21·3	245	21·3
St. Paul's	18·7	503	21·5
Kotahena	23·2	1,403	30·4
New Bazaar	23·7	636	27·2
Maradana	19·3	1,634	28·4
Slave Island	25·8	564	26·2
Kollupitiya*	20·8	382	16·1
Wellawatta	17·1	707	26·6
Hospitals	—	2,614	—

* This includes only the northern half of the old Kollupitiya Ward.

4.—Deaths.

8,169 deaths, including 1,130 deaths in the hospitals of non-residents of the town, were registered during the year, giving a crude rate of 33·5 per 1,000 of population, as against the average crude rate of 30·0 and a crude rate of 29·1 in 1920. If, however, the deaths in hospitals of non-residents, all of whom came sick to the town, are excluded, as they properly should be, the death-rate was only 28·8, which is a shade lower than the corrected rate for 1920 (29·0).

The statements below show the death-rates for each race, and in the various wards of the town. The consistently high general death-rate amongst the Malays is a disturbing feature of the statistics, the principal cause being the very high mortality from pulmonary diseases, especially amongst Malay women, and from diarrhœal diseases. Thus, the mortality from pulmonary diseases during 1921 amongst all races was 6·88 per 1,000 for males, and 8·90 for females, whereas the corresponding rates amongst the Malays were 7·16 for males and 14·51 for females. No other race shows such a high pulmonary death-rate nor such a huge discrepency between their male and female death-rates. It is probable that the smallness of the Malay population, viz., only 5,852 in all out of the total population of all races of over quarter of a million, has led to a good deal of inbreeding, with its inherent harmful effects upon the stock, and that, consequently, an unusual proportion of this race has inherited a predisposition to pulmonary diseases. If to this is added the fact that the women do most of the nursing of their sick relatives and lead a more confined life than the men do, we have a set of conditions very favourable to a high incidence and mortality from pulmonary diseases amongst them.

The consistently high birth-rate amongst the Malays would appear to be Nature's gallant attempt to preserve a naturally sturdy race which is threatened with decimation here.

(7) *Colombo Ward Death-rates (all Causes) in 1921. Death-rate per 1,000 Population.*

Ward.	Average Crude Death-rate, 1911 to 1920.	Deaths, 1921.	Death-rate (Crude), 1921.	Death-rate (corrected for Deaths in Hospitals), 1921.	Death-rate (corrected for Deaths in Hospitals), 1920.	Increase or Decrease, 1921, as compared with 1920.
Colombo	30·0	8,169*	33·5	28·8	29·0	— 0·2
Fort	13·8	32	11·9	13·4	17·6	— 4·2
Pettah	10·4	79	10·4	22·9	22·7	+ 0·2
San Sebastian	24·0	282	24 5	28·7	25·9	+ 2·8
St. Paul's	26·1	658	28·1	33·1	33·4	— 0·3
Kotahena	22·9	1,129	24·5	28·4	33·6	— 5·2
New Bazaar	26·4	715	30·6	37·7	31·4	+ 6·3
Maradana	21·0	1,230	21·4	28·6	27·8	+ 0·8
Slave Island	25·2	596	27·6	33·7	33·8	— 0·1
Kollupitiya	19·7	356	15·0	18·9	29·5	—10·6
Wellawatta	12·5	370	13·9	17·7	13·5	+ 4·2
Hospitals	—	2,722	—	—	—	—

* Inclusive of 1,130 deaths of non-residents of the town.

(8) *Race Death-rates. Colombo Racial Death-rates (all Causes) in 1921. Death-rate per 1,000 Population.*

Ward.	(a) Average Crude Death-rate, 1911 to 1920.	(b) Deaths, 1921.	(c) Crude Death-rate, 1921.	(d) Rate corrected for Deaths in Institutions.	(e) Increase or Decrease on the Average (Crude).	(f) Decrease due to correction for Institutions.
All Races	30·0	8,169	33·5	28·8	+ 3·5	4·7
Europeans	19·1	51	16·5	11·4	— 2·6	5·1
Burghers	24·6	349	23·9	22·7	— 0·7	1·2
Sinhalese	32·8	4,268	37·2	29·0	+ 4·4	8·2
Tamils	27·6	1,597	29·1	27·3	+ 1·5	1·8
Moors	27·9	1,356	33·9	30·6	+ 6·0	0·3
Malays	35·1	256	43·5	43·0	+ 8·4	0·5
Others	29·1	292	26·4	23·1	— 2·7	3·3

5.—Principal Causes of Deaths.

As the following table shows, pneumonia, as usual, headed the list, followed by phthisis, debility infantile convulsions, and diarrhœa

(9) *Principal Causes of Deaths at all Ages in 1921.*

Pneumonia		950	Total Pulmonary, 1,870
Phthisis*		737	
Bronchitis		183	
Diarrhœa	583	216	All Diarrhœal, 831
Enteritis		367	
Dysentery		248	
Enteric fever*		219	Fevers, 400
Remittent fever		112	
Intermittent fever		—	
Simple and ill-defined fever*		69	
Debility		692	
Influenza		191	
Infantile Convulsions		602	

Certain Minor Causes of Deaths.

Anchylostomiasis	213	Syphilis	54
Intestinal parasites	174	Measles*	—
Paralysis	108	Diphtheria*	5
Rickets	89	Whooping cough*	7
Plague*	176	Rabies	2
Cancer	77	Smallpox*	4
Tetanus	58	Beri-beri	3†

* Those marked with an asterisk are notifiable. † From ships in the harbour.

6.—Infant Mortality.

2,098 children died before completing their first year of life, the infant death-rate per 1,000 registered births being 240, as compared with the average rate during the previous ten years of 252, and the rate of 233 in 1920. The principal causes of these infant deaths were convulsions, debility, pneumonia, and diarrhœa.

A good deal of maternity and child welfare work has already been done in Colombo, as described in section 28, and there is reason to hope that this very important branch of work will receive further encouragement and support in the near future.

(10) *Infant Mortality, 1921, by Wards. Rate per 1,000 Births.*

Ward.	Average, 1911 to 1920.	1921.	Increase or Decrease.
Colombo	252	240	— 12
Fort	(8) 259	(8) 250	— 9
Pettah	(4) 326	(1) 500	+ 174
San Sebastian	(3) 338	(4) 412	+ 74
St. Paul's	(1) 386	(2) 457	+ 71
Kotahena	(7) 268	(7) 251	— 17
New Bazaar	(2) 355	(3) 413	+ 58
Maradana	(5) 316	(6) 256	— 60
Slave Island	(6) 283	(5) 360	+ 77
Kollupitiya	(9) 218	(9) 220	+ 2
Wellawatta	(10) 215	(10) 192	— 23
Hospitals	145	257	+ 112

(11) *Infant Mortality, 1921, by Races. Rate per 1,000 Births.*

	All Races.	Europeans.	Burghers.	Sinhalese.	Tamils.	Moors.	Malays.	Others.
All causes	240	60	164	194	386	351	316	274
Premature birth	10	12	9	10	19	4	14	12
Atrophy and debility	67	—	44	53	112	97	106	65
Bronchitis	10	12	12	7	21	14	23	6
Pneumonia	25	—	22	24	30	33	20	12
Diarrhœal	24	—	21	21	24	29	50	24
Convulsions	69	—	33	49	121	136	60	101
Tetanus	2	—	2	1	4	3	—	—
All other causes	33	36	21	29	55	35	43	54

7.—Infectious Diseases.

The following statement shows the number of cases of each of the notifiable infectious diseases reported during each month of the year.

There was a marked reduction of plague which was reduced to a few sporadic cases after March ; smallpox was entirely eradicated in February, only one imported case occurring during the remainder of the year ; the epidemic of measles died out towards the middle of the year ; while enteric fever showed a marked reduction, there being only 572 cases reported, as compared with 879 cases during 1920. No case of cholera occurred during the year.

(12) *Notifiable Infectious Diseases, 1921.*

Disease.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total for Colombo, exclusive of Port and outside cases.	Port Cases.	Outside Cases.	Grand Total of Cases.
Plague	65	53	27	7	2	1	3	2	2	9	4	9	184	2	—	186
Cholera	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Smallpox	10	1	—	1	—	—	—	—	—	—	—	—	12	3	—	15
Chickenpox	69	83	144	141	50	11	18	57	46	37	32	23	711	6	56	773
Measles	28	18	35	30	10	39	9	9	2	—	6	4	190	4	13	207
Diphtheria	4	1	1	1	4	1	—	3	1	1	2	1	20	1	2	23
Acute diarrhœa	—	—	—	—	1	—	—	1	—	—	—	—	2	—	—	2
Enteric fever	62	34	37	34	27	21	30	28	41	32	27	25	398	12	162	572
Continued fever	21	14	28	13	13	5	14	11	9	27	16	16	187	—	13	200
Phthisis	164	114	106	140	162	105	121	89	101	110	86	69	1,367	4	250	1,621
Scarlet fever	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Typhus fever	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	423	318	378	367	269	183	195	200	202	216	173	147	3,071	32	496	3,599

8.—Pulmonary Diseases.

This group, which includes pneumonia, phthisis, and bronchitis, of which phthisis alone is notifiable, was responsible during 1921 for 1,870 deaths, representing a rate of 7·66 per 1,000, or 23 per cent. of the total deaths from all causes. As diagram V. shows, the mortality from this group has steadily fallen during the three years which followed the great rise in 1918 caused by influenza. It has not yet, however, returned to the pre-influenza level.

(*a*) *Pneumonia.*—Deaths, 950 ; death-rate, 3·89 per 1,000. This is an improvement compared with the previous three years. This disease was most prevalent during the months of January, February, and May. Malays had the highest death-rate from this cause, closely followed by the Sinhalese.

(*b*) *Phthisis.*—1,621 cases of this disease were reported, including 4 cases from ships and 250 cases from outside the town, the total number of town cases being 1,367, as against 1,361 cases in the previous year. 737 deaths from this cause occurred, as against 729 during 1920, the rate per 1,000 of population being exactly the same in the two years. Here, again, the Malays had the highest death-rate, the mortality amongst Malay females being twice as high as amongst Malay males. No other race shows such a discrepancy between their male and female phthisis death-rates. The distribution of all cases of this disease reported during 1921 is shown in the accompanying spot map.

(*c*) *Bronchitis.*—Deaths, 183 ; death-rate 0·75 per 1,000, which is a slight increase compared with the previous year.

(13) *Pulmonary Diseases, 1921, by Race. Rate per 1,000 Population.*

		All Races.	Europeans.	Burghers.	Sinhalese.	Tamils.	Moors.	Malays.	Others.
Phthisis	Deaths	737	1	27	422	120	104	26	37
	Death-rate	3·02	0·32	1·85	3·68	2·18	2·60	4·42	3·35
Pneumonia	Deaths	950	3	42	497	187	140	29	52
	Death-rate	3·89	0·97	2·89	4·34	3·40	3·50	4·93	4·71
Bronchitis	Deaths	183	1	12	71	43	46	9	1
	Death-rate	0·75	0·32	0·82	0·62	0·78	1·15	1·53	0·09
All pulmonary	Deaths	1,870	5	81	990	350	290	64	90
	Death-rate	7·66	1·61	5·56	8·64	6·36	7·25	10·88	8·15

(14) *Death-rates from Pulmonary Diseases amongst the Indigenous Races, 1909 and 1917 to 1921.*

	Males.						Females.					
	1909.	1917.	1918.	1919.	1920.	1921.	1909.	1917.	1918.	1919.	1920.	1921.
Burghers	7·56	7·02	8·83	8·00	6·03	6·59	9·12	6·28	9·91	6·97	6·28	4·55
Sinhalese	11·49	5· 1	10·62	9·50	9·19	8·24	11·23	6·68	11·95	9·79	9·12	9·11
Moors	10·26	3·72	7·33	5·47	5·06	6·02	13·59	5·43	11·26	8·35	9·30	9·37
Malays	9·45	6·07	10·21	6·39	8·95	7·16	15·06	9·08	14·16	8·34	12·33	14·51
All Races	11·39	5·37	9·07	8·11	7·50	6·88	11·96	6·62	11·85	9·11	9·12	8·90

9.—Influenza.

Only 191 deaths were ascribed to this cause during 1921, as against 253 in 1920, 421 in 1919, and an estimated number of about 1,000 in 1918. This disease, although markedly on the wane, still showed the usual tendency to recrudesce in two waves, one beginning in April and lasting during May and June, and the other beginning in November and carrying on into the succeeding year. It was not, as a rule, accompanied by serious complications, nor were its manifestations limited to any one type, a certain number of cases being reported to have assumed respectively the nervous, bronchial, and gastric types. The deadly pneumonic type, which was such a marked feature of the second great wave during 1918, was conspicuously absent.

10.—Diarrhœal Diseases.

This group, which includes diarrhœa, enteritis, and dysentery, none of which are notifiable, was responsible for 831 deaths, representing a rate of 3·41 per 1,000, as against a rate of 3·59 during the previous year.

(*a*) *Diarrhœa and Enteritis.*—Deaths, 583 ; death-rate 2·39 per 1,000, as against 2·50 per 1,000 in the previous year. Much the highest death-rate from this cause occurred amongst the Malays.

(*b*) *Dysentery.*—Deaths, 248 ; death-rate 1·02 per 1,000, as against 1·09 in the previous year. The Tamils, followed closely by the Sinhalese, had the highest death-rate from this cause.

(15) *Diarrhœal Diseases, 1921, by Race. Rate per 1,000 Population.*

		All Races.	Europeans.	Burghers.	Sinhalese.	Tamils.	Moors.	Malays.	Others.
Diarrhœa and enteritis	Deaths	583	3	31	306	123	81	25	14
	Death-rate	2·39	0·97	2·12	2·67	2·24	2·03	4·25	1·27
Dysentery	Deaths	248	1	11	124	66	32	5	9
	Death-rate	1·02	0·32	0·75	1·08	1·20	0·80	0·85	0·81
All diarrhœal	Deaths	831	4	42	430	189	113	30	23
	Death-rate	3·41	1·29	2·87	3·75	3·44	2·83	5·10	2·08

11.—Fevers.

Under this heading are included enteric fever, simple continued fever of not less than seven days' duration, remittent and intermittent fevers, of which only enteric and simple continued fever are notifiable. This group caused a total of 400 deaths, representing a death-rate of 1·64 per 1,000, as against a rate of 1·78 during the previous year.

(*a*) *Enteric Fever.*—Cases, 572; deaths, 219 ; case mortality, 38·3 per cent.; case-rate, 2·34 per 1,000 of population ; death-rate, 0·90 per 1,000 of population. This is a very great improvement compared with the previous year, when 879 cases, with 338 deaths, were reported. The ill-kept bucket latrine being, next to direct contact with infected cases, probably one of the most fruitful sources of infection in enteric fever, a special effort was made during the year to improve their condition by carrying out special latrine inspections in the poor quarters all over the town. The accompanying spot map shows the distribution of all known cases of enteric and simple continued fever, from which it will be seen that the incidence of continued fever tends to be specially high in the Maradana and Wellawatta areas. In the light, however, of subsequent knowledge in regard to the appearance of indigenous malaria in Colombo towards the end of the year, the distribution of these continued fever cases raises the suspicion that a number of them may have been malaria.

(16) *Fevers, 1921. Cases, Deaths, and Rates per 1,000 Population of each Race.*

		All Races.	Europeans.	Burghers.	Sinhalese.	Tamils.	Moors.	Malays.	Others.
Enteric fever	Cases	572	15	60	381	46	33	8	29
	Case-rate	2·34	4·86	4·12	3·34	0·84	0·88	1·36	2·62
	Deaths	219	4	18	144	19	20	2	12
	Death-rate	0·90	1·30	1·23	1·26	0·35	0·50	0·34	1·09
Continued fever	Cases	200	—	16	130	28	17	6	3
	Case-rate	0·82	—	1·10	1·13	0·51	0·43	1·02	0·72
	Deaths	69	—	2	45	13	7	—	2
	Death-rate	0·28	—	0·14	0·39	0·24	0·18	—	0·18
Remittent fever	Deaths	112	2	5	47	25	19	3	11
	Death-rate	0·46	0·65	0·34	0·41	0·45	0·48	0·51	1·00
Intermittent fever	Deaths	—	—	—	—	—	—	—	—
	Death-rate	—	—	—	—	—	—	—	—
All fevers	Cases	772	15	76	511	74	50	14	32
	Case-rate	3·16	4·86	5·22	4·47	1·35	1·31	2·38	3·34
	Deaths	400	6	25	236	57	46	5	25
	Death-rate	1·64	1·95	1·71	2·06	1·04	1·16	0·85	2·27

(17) *Fevers by Wards, 1921. Cases and Case-rate per 1,000 Population.*

		Colombo.	Fort and Galle Face.	Pettah.	San Sebastian.	St. Paul's.	Kotahena.	New Bazaar.	Maradana.	Slave Island.	Kollupitiya.	Wellawatta.	Port.	Outside.	Untraced.
Enteric fever	Cases	572	2	2	13	18	75	27	117	22	29	36	12	162	57
	Case-rate	2·34	·74	·26	1·13	·77	1·63	1·16	2·03	1·02	1·22	1·35	—	—	—
Continued fever	Cases	200	—	1	3	10	39	14	65	9	6	30	—	13	10
	Case-rate	0·82	—	·13	·26	·43	·84	·60	1·13	·42	·25	1·13	—	—	—
All fevers	Cases	772	2	3	16	28	114	41	182	31	35	66	12	175	67
	Case-rate	3·16	·74	·39	1·39	1·20	2·47	1·76	3·16	1·44	1·47	2·48	—	—	—

(18) *Enteric Cases reported during 1921 (inclusive of Port and Outside Cases). Distribution by Race, Age, and Sex.*

Race.	Sex.	0 to 5 Years.	5 to 10 Years.	10 to 15 Years.	15 to 20 Years.	20 to 25 Years.	25 to 30 Years.	30 to 35 Years.	35 to 40 Years.	40 to 50 Years.	50 to 60 Years.	60 and over.	All Ages.	Total of each Race.	Case Rate per 1,000 Population.	Deaths.	Case Mortality Per Cent.	Mortality per 1,000 Population.
All Races .	Males	8	30	41	52	74	52	32	18	27	9	3	346	572	2·34	219	38·3	0·90
	Females	8	20	49	34	28	33	14	12	17	6	5	226					
Europeans	Males	—	—	—	—	2	—	1	3	2	1	—	9	15	4·86	4	26·7	1·30
	Females	—	—	—	1	1	—	2	1	1	—	—	6					
Burghers . .	Males	1	3	7	3	2	5	3	3	6	1	—	34	60	4·12	18	30·0	1 23
	Females	4	1	3	6	2	2	2	2	2	1	1	26					
Sinhalese . .	Males	6	22	30	36	49	29	20	5	16	6	1	220	381	3·34	144	37·8	1·26
	Females	3	14	37	24	21	26	8	7	13	5	3	161					
Tamils . .	Males	1	2	2	8	7	4	1	4	2	—	2	33	46	0·84	19	41·2	0·35
	Females	—	3	3	—	1	1	2	1	1	—	1	13					
Moors . .	Males	—	2	—	1	5	5	3	1	1	1	—	19	33	0·88	20	60·6	0·50
	Females	1	1	5	3	2	2	—	—	—	—	—	14					
Malays . .	Males	—	1	1	—	—	1	—	—	—	—	—	3	8	1·36	2	25·0	0·34
	Females	—	1	1	—	—	2	—	1	—	—	—	5					
Others . .	Males	—	—	1	4	9	8	4	2	—	—	—	28	29	2·62	12	41·3	1·09
	Females	—	—	—	—	1	—	—	—	—	—	—	1					

(*b*) *Malaria.*—With the exception of a somewhat severe, but strictly localized outbreak of locally-acquired malaria, which occurred at Fisher's quarters, Mutwal, in 1903–04, and which was traced to the breeding of large numbers of *Anopheles culicifacies* in the Government quarry, Colombo has hitherto been justly regarded as being practically free from indigenous malaria. The discovery and abolition of the breeding places of these mosquitoes in 1904 quickly brought that outbreak to an end.

Anopheles mosquitoes in Colombo.—Major (now Lieut.-Colonel) James, I.M.S., who carried out a very comprehensive and thorough mosquito survey of Colombo in 1913, recorded the finding of eight different species of anopheles in the town; but stated that none of these appeared to be present in sufficient numbers to cause an outbreak of malaria. He specially mentions the fact that he did not find either *A. culicifacies,* which is the chief malaria carrier in some parts of India and in the northern part of Ceylon, or *A. maculatus,* another well-known malaria carrier in India, Malaya, and China, and which is abundant on tea estates in hilly districts in Ceylon.

The species of anopheles, recorded by Major James, in Colombo are :—

1. A. rossii	3. A. barbirostris	5. A. tessalatus	7. A. ludlowii
2. A. jamesii	4. A. fuliginosus	6. A. albirostris	8. A. sinensis

of these, *rossii*, *jamesii*, and *barbirostris* are stated by Major James to be the most numerous, none of which, however, are so far as is known, carriers of malaria in nature ; *fuliginosus* is a known carrier, but seems to be too scarce here to be of much importance ; *tessalatus,* which is said to be an important carrier in Malaya and New Guinea, has been found breeding over a fairly wide area in Colombo ; not very much is, however, known about its habits; *albirostris*, or *minimus* var. *aconitus,* which is an important carrier in Malaya and China, does not appear to be common here, and has not recently been found by us; *ludlowii*, which is an important malaria carrier in the Andaman Islands, Malaya, and the Dutch East Indies, is peculiar, in that it breeds freely in brackish or even in highly concentrated sea water ; it used to be found breeding in the salt water rock pools at Galle Buck and occasionally in the bilge water of barges in the harbour, but it has not recently been found by us in Colombo ; *sinensis :* This anopheles has long been known in Colombo, having, in common with *barbirostris, rossii*, and others, been found by me in 1904 in practically all the swamps in Colombo. It has not, however, been found prior to 1921, except in small numbers, and it has not hitherto been regarded as a probable malaria carrier here ; its distribution here has certainly not been associated with the occurrence of indigenous malaria hitherto. During 1921, however, it was found by us breeding in extraordinarily large numbers in certain parts of the town, notably in the pond for aquatic plants within the Victoria park gardens, in various trenches and ditches near Guildford crescent, in a trench at Jawatta road, in the Dehiwala canal, in the Forbes road swamp, and in the lake reclamation opposite Norris road. As its prevalence and distribution in 1921, coupled with the occurrence of indigenous malaria, raised the suspicion that it might now be carrying malaria here, I consulted Mr. Henry F. Carter, the Government Malariologist, who kindly furnished me with the following notes in regard to this mosquito, and also very kindly offered to undertake dissections of the insect, with a view to discovering whether it was connected in any way with malaria here. So far, however, we have been unable, owing to the abolition of all its breeding places in the infected parts of the town, to obtain specimens suitable for examination in this connection.

Mr. Carter's Notes.

" Until quite recently it has been considered that *A. sinensis* (although known to be capable of harbouring the parasites) was of very little importance as a natural carrier of malaria. But in view of Walch's paper (referred to in the above account) it would appear that in certain circumstances, and when present in large numbers, this species may be an active agent in transmission.

"*A. sinensis* Wied.

"So far as I am aware the evidence (other than epidemiological) regarding *A. sinensis* and transmission of malaria is as follows :—

"1. Grassi, 1899. Experimentally infected *A. sinensis* var. *pseudopictus* in Italy with M. T. & S. T.

"2. As *A. jesœnsis* Tsuzuki (1901) infected it with parasites of S. T. & Q. in Japan.

"3. Kinoshita (1904) experimentally infected it with S. T. & Q., but previously (1903) stated that it invariably gave negative results in all experiments.

"4. Ghosh (India), 1912. 56 wild specimens dissected, all negative.

"5. Stanton (1912) found two specimens naturally infected (oöcyst stage) in 98 examined, but was unable to infect it experimentally.

"6. Walker and Barber failed to infect it in the Philippines.

"7. Barber (Philippines, 1918) obtained experimental infection with (?) S.T. in 1 of 64 specimens. Dissections of 22 ' wild ' specimens, negative.

"8. Swellen Grebel and De Graaf (1919) obtained experimental infection with S. T. in Malaya ; also experimental transmission of S. T.

"9. *Walch and Walch—Sorgdrager*, 1921. Found that it was the chief agent in causing an epidemic (S. T. & M. T.—few Q.) on a coconut estate in Dutch Indies. Of 7,257 dissected, 107, or 1·5 per cent., were found infected. Other Anopheles were present, and some were also carrying the parasite, but of the infected *anopheles* obtained, *A. sinensis* formed 84 per cent."

The appearance of Indigenous Malaria in Colombo.—With the exception of the localized outbreak which occurred at Mutwal nineteen years ago, to which reference has already been made, Colombo has hitherto been, so far as one has been able to ascertain, practically free from indigenous or autochthonus malaria.

There was, it is true, a single and apparently locally infected case reported from Maitland crescent in April, 1919, in connection with which a few larvæ, of what were identified by us as *A. culicifacies*, were found in a pool in an adjoining grassfield ; but no further indigenous case was reported until nearly two years later, when in February, 1921, four apparently locally acquired cases were reported from adjacent bungalows in Cambridge place and Guildford crescent.

A very thorough search in this locality disclosed, as usual, numerous anopheles breeding places, notably in the low-lying Crown land at the Thurstan road-Guildford crescent junction ; within the grounds of the Government Training College ; and in the hollow behind Flower road. The anopheles collected on this occasion included, as usual, *rossii, jamesii, barbirostris*, a few *fuliginosus*, and one damaged specimen of *sinensis* caught in one of the infected houses, but no known malaria carriers other than *fuliginosus* were found. Steps were, however, at once taken to, as far as possible, abolish all these breeding places, including a vote by Government of Rs. 22,000 for the filling up of the low-lying Crown land near the junction of Cambridge place and Guildford crescent. Nothing further occurred thereafter until August, when a case was reported from Torrington place, followed in October by another from Guildford crescent, and a third in November from Darley road, while four cases of "fever," possibly malaria, were reported to have occurred at Brownrigg road in December.

Disturbed by the occurrence of this series of apparently locally acquired cases, which seemed to indicate that some new factor had come into operation within the best residential quarter of the town, a special mosquito survey was again carried out, a wide area being covered, including the lake, the race course, the Ladies' Golf Links, the Victoria Golf Links, and most of the adjacent streets. The result of this work was the collection of a large number of anopheles larvæ, which were developed at the office, and a selection of the mosquitoes were then sent in November to Mr. Carter, who kindly undertook their identification, with the following interesting, but disturbing, result :—

A. rossii and *A. barbirostris* from Victoria Golf Links, *A. tessalatus* from Torrington place, and *A. listoni* from Maitland crescent and the Ladies Golf Links.

A. listoni is a notorious malaria carrier in India and elsewhere, and as this was the first occasion upon which it had ever been recorded in Colombo, a survey on a larger scale than hitherto was at once organized, with the result that this dangerous mosquito was found breeding in very large numbers in various pools, trenches, and ditches at Jawatta road, and to a less extent in the swamp behind Pendennis avenue and Green path in Kollupitiya.

An outbreak of malaria having been reported in November amongst the employees at the Municipal quarry at Kirillapone, outside and to the south of the town, an investigation was made there, with the result that large numbers of *A. listoni* were found breeding within the quarry and in the adjacent rural locality. When, upon the occurrence of further cases in the town during January, 1922, inquiries were made from medical practitioners, the information was elicited that malaria had been unusually prevalent during the latter part of 1921 in the villages and rural districts to the south and south-east of the town, and also in the extreme southern part of the town itself. The outside villages specially mentioned as being thus affected were Kirillapone, Nawala, Welikada, Cotta, Talangama, Rajagiriya, Udahamulla, and Battaramula, while within the town Timbirigasyaya, Narahenpita, Wellawatta, and Kapuhentuduwa were specially mentioned.

It is worthy of note that the prevalence of this disease was said to have begun in the rural districts in November, a maximum being reached in December, whereas the town cases were said to have begun chiefly in December and reached a maximum in January, 1922. Practically the whole of the area so affected lies, as will be seen, to the south and south-cast of the town.

A consideration of the available facts thus leads one to the conclusion that (*a*) the appearance of indigenous malaria in Colombo in 1921 was primarily the result of an abnormal prevalence of the disease in the rural districts to the south and south-east of the town, from which it spread by means of *A. listoni* into the adjacent southern parts of the town, (*b*) subsequently, when the number of foci of infection within the town increased as the result partly of the arrival of unusual numbers of people infected in other parts of the Island, *e.g.*, the Maho-Batticaloa and Puttalam railway extension, and partly as the result of

locally acquired infection transmitted by *A. listoni*. *A. sinensis* may, as indicated by Mr. Carter's notes quoted above, have begun to act as a carrier in certain parts of the town, where it was present in exceptionally large numbers, *e.g.*, in the vicinity of Victoria park, Timbirigasyaya, and Norris road.

In support of the statement that malaria was unusually prevalent during 1921 in the rural districts adjacent to the town, I am enabled through the courtesy of the Principal Civil Medical Officer to quote he following statistics of cases treated in the Government Hospitals :—

(19) *Malaria Cases Treated.*

Year.	All Ceylon.	Western Province, exclusive of Colombo General Hospital.	Colombo General Hospital.
1920	16,538 ..	2,807 ..	767
1921	27,447 ..	4,036 ..	1,119
Increase in 1921 ..	10,909	1,229	352

Mode of spread of Malaria in 1921.—On looking at a map of the Colombo District one cannot fail to be struck by the fact that the rural areas, which are reported by the medical practitioners to have been chiefly affected, are all in proximity to low-lying swampy lands, which, under normal conditions of rainfall, are covered twice annually by floods. During 1921, however, with a total rainfall of only 53·56 inches, as compared with the average of 78·91 inches, the normal flooding did not occur, and it is suggested that herein probably lies the explanation of the unusual prevalence and spread of malaria during the year.

During years of normal rainfall, the whole of the low-lying lands around, and in some places within the town, are completely covered twice a year by a sheet of fairly deep, open water in which fish abound, and in which mosquito larvæ can find no refuge from the fish which prey upon them. Malaria has, under such conditions, comparatively little chance of spreading. When, however, the floods subside, or as happened in 1921 they do not occur, these sheets of open water gradually drain away and evaporate leaving a series of isolated, shallow, and weed-grown pools, which may or may not contain fish, but which certainly afford ample food and protection for mosquito larvæ. Under such conditions it is certain that mosquitoes thrive and multiply exceedingly, and in course of time, unless interrupted by a flood, will spread from pool to pool, thus, by a process described by Major James as gradual infiltration, widening their area of distribution beyond its normal limits. It is suggested that this is what occurred during the prolonged drought in 1921, and that thus *A. listoni*, which has doubtless been long present in these rural areas, where, as is known, indigenous malaria has existed for many years past, has thus been enabled to at least reach Colombo, and cause the appearance of indigenous malaria within the town.

If the above is the correct explanation of the abnormal prevalence and spread of malaria in the Colombo District during 1921, the question naturally arises as to what will happen if the proposed scheme for preventing floods in the Colombo District is carried out.

Upon mentioning some time ago to Dr. Bentley, the Sanitary Commissioner for Bengal, that such a scheme had been proposed here, he at once remarked that if that scheme is carried out, we had better look out for malaria, a remark which he explained by stating that the shutting out of the periodical floods in a certain area in Bengal, by the building of a railway embankment, had resulted in an area, which previously had a low incidence of malaria, being converted into a highly malarious and consequently unhealthy one, and that the expenditure of a very large sum of money would be required to put it right.

When considering the facts in regard to the appearance of indigenous malaria in Colombo as recorded above, Dr. Bentley's remark naturally recurred to one's mind, and, in fact, suggested the explanation of the outbreak in 1921, which I have given above.

Be the explanation what it may, it would appear to be desirable that the facts in regard to flood prevention and malaria, in so far as they are known or can be ascertained, should be carefully considered by the Engineers in connection with any proposal to artificially exclude the floods from the Colombo District. If the explanation which is suggested above, of the abnormal prevalence and spread of malaria during 1921, is the correct one, it would appear to be necessary that any scheme for the prevention of floods here should make provision for reclamation, including the prompt and thorough filling up or draining of all pools which may form, and for the periodical flushing of all canals. Provided these matters, which it is feared will be very costly and will take time, are attended to, it is difficult to see how anything but good can *ultimately* result from the exclusion of the floods from the Colombo District.

Before leaving this subject, it may be well to point out that the invasion of Colombo by autochthonous malaria in 1921 is the strongest possible argument in favour of immediately adopting the repeatedly sought, but long deferred, legislation for the prevention of mosquito breeding within the town. If the population of the town once becomes generally infected with malaria, it will be exceedingly difficult and costly to eradicate it, owing to the practically permanent persistence of the parasite in those who become infected.

12.—Plague.

The recrudescence of plague which began in September, 1920, reaching a maximum with 27 cases during the week ending December 11, continued during the first seven weeks of January, 1921, when, however, it began suddenly to decline, as the result partly no doubt of the onset of the hot weather, but partly also, it is believed, as the result of the special preventive measures which were initiated during December, 1920, an account of which was given in section 13 of the Annual Report for that year. That this improvement was, in fact, attributable in no small degree to the preventive measures adopted, and not to climatic conditions, is clearly established by Mr. Bamford in his very interesting and valuable report.

MR. BAMFORD'S REPORT.

M. 314.

Colombo Observatory,
February 17, 1922.

"IN continuation of my letter of April 25, 1921, I have the honour to submit the attached diagram and notes dealing with the figures for 1921.

"1. In the diagram are shown :—

"(*a*) A curve derived from humidity and wet bulb for this year similar to those drawn previously, *i.e.*, for each week the quantity (humidity per cent.—70 per cent.)—2 (wet bulb in °F—70 °F) has been estimated. These results have been smoothed by taking the mean of each consecu tive three points, and the smoothed curve so obtained is shown as a firm black line and is referred to henceforth as H.

"(*b*) A corresponding curve giving the means for the past seven years is shown as a black chain line built up from monthly means not smoothed.

"(*c*) A series of bars giving the Fort rainfall for the weeks in question R.

"(*d*) A curve of plague cases is shown by a firm red line. This has been smoothed like H by taking points in groups of three, but in this diagram no attempt has been made to allow for lag by setting it alongside the H curve of three weeks earlier as was done in a previous report. This curve is referred to as P.

"(*e*) A curve derived by the same method as P from the mean results of the previous seven years is shown as a dotted red line.

"2. On examining these curves several points are apparent. The most obvious generalization is that in both the plague (red) and humidity (black) curves the 1921 values are above the average for the first quarter, and, on the whole, below it for the remainder. This, as far as it goes, is a rough support for the idea that the two are connected, but its value must not be over emphasized ; even if the parallelism had been much closer, it would not have proved P's dependence on H, since clearly the variations of both might be the outcome of some third, as yet unspecified, cause.

"3. Looking at the curves in more detail and comparing them first without any 'lag' allowance, it will be seen that in March P drops before H, so that it is clear that even if humidity conditions assisted to keep plague down in May and June they certainly cannot take the credit of the drop at the end of March and beginning of April. Also the three weeks lag, if included, would have had the effect of making the drop in P all the more ahead of the movements of H, and so presumably independent of them.

"4. It is possible that the whole of the red curve from May onwards should be dismissed as 'plague cases very low, and situation absolutely in hand,' but if we take the plague figures of the last quarter as worthy of notice, we must recognize that at the beginning of August a rise in H was practically unaccompanied by plague, and a further rise in October was accompanied by very little, that is to say, that the restriction of plague at these times must be attributed to non-climatic factors, since (so far as the short experience available admit of a deduction) the atmospheric conditions were favourable.

"5. The curve R raises several new points, and it is on account of uncertainty about its effect that figures are plotted under actual dates, since it is quite conceivable that the chief effect of the H curve might occur after an interval of (say) three weeks and that of the R curve might be almost instantaneous (*e.g.*, by rain driving people from the open into infected houses), also moderate rainfall, which may drive people into unhealthy shelter and perhaps drown a few rats in sewers, may have an opposite effect to heavy rainfall, which is sufficient to raise the entire level of ground water and drive rats upwards on a large scale. In this connection it must be remembered that 1921 was a year of low rainfall at Colombo.

"There is a tempting opportunity to compare H, R, and P as they stand on the assumption that increase in R has an anti-plague effect. Thus, if we compare H and P directly, the chief dates when H is high without a corresponding rise in P are the weeks ending April 2 and 9, May 7, August 6, October 15 and 29, and November 5, in all of which R was appreciable, and conversely rises in P without a rise in H coincided with a fall off in R on February 5 to 12 and November 12 to 19. This suggests that we might include in our basis-curve, as well as the terms (humidity—2 wet bulb), another negative one—A (rain), the chief objection to which is the difficulty in getting a constant value for 'A,' since the value of a couple of inches of rain in a week may be intense after a period of drought, and almost inappreciable at the end of a wet period.

"6. There remain, however, some most noteworthy drops in P without any explanation from either H or R, whether taken simultaneously or displaced three weeks later, *e.g.*, February 19 to March 5, so that the addition of a rainfall term, though interesting as a study in correlation, certainly does not shake the main contention in paragrah 3, viz., that the restriction of plague through 1921 must have been primarily non-meteorological.

A. J. BAMFORD,
Superintendent, Observatory."

(20) *Plague : Cases, 184 ; Deaths, 170 ; Case Mortality, 92·4 per Cent.*

Plague, 1914 to 1921.

	1914.	1915.	1916.	1917.	1918.	1919.	1920	Average 1914–1920.	1921.
Total cases	413	139	291	207	70	87	235	206	184
Total deaths	381	128	273	196	69	82	223	193	170
Septicæmic cases	247	81	159	124	41	50	93	113	70
Septicæmic deaths	246	80	159	124	41	50	93	113	70
Bubonic cases	166	58	132	83	29	37	142	93	114
Bubonic deaths	135	48	114	72	28	32	130	80	100
Total cases mortality, per cent.	92·2	92·8	93·8	94·7	98·6	94·3	94·9	93·9	92·4
Septicæmic cases mortality, per cent.	99·6	98·7	100·0	100·0	100·0	100·0	100·0	100·0	100·0
Bubonic cases mortality, per cent.	81·3	82·8	86·4	86·7	96·6	86·5	91·5	86·3	87·7
Septicæmic, per cent.	59·8	58·0	54·6	59·9	58·5	57·5	39·6	54·9	38·1
Bubonic, per cent.	40·2	42 0	45·4	40·1	41·5	42·5	60·4	45·1	61·9

As diagram VIII. shows the incidence of plague was much above the average during the first two months of the year; but thereafter fell rapidly, and remained markedly below the average during the ensuing "plague season," which normally commences in September. As Mr. Bamford has pointed out, if the incidence of plague cases had remained uncontrolled, and subject only to the influence of the climatic conditions, it should not have fallen as it did at the end of March, and it should have increased at the beginning of August and again in October, in accordance with its usual behaviour under the climatic conditions which prevailed at that time, whereas, on the contrary, as Mr. Bamford says, plague cases remained "very low, and situation absolutely in hand."

The following statement shows the number of cases and the mean temperature, rainfall, and humidity during each month of the year :—

(21) *Plague, 1921. Cases Reported. Monthly Incidence.*

Month.	Plague Cases.	Mean Temperature. °	Rainfall. Inches.	Mean Humidity per Cent.
January ..	65	79·8	7·55	78
February ..	53	78·6	0·19	75
March	27	80·9	4·90	80
April	7	81·7	8·97	82
May	2	83·8	5·09	79
June	1	83·0	1·50	78
July	3	82·0	5·12	77
August	2	81·2	3·44	80
September ..	2	82·4	0·94	75
October ..	9	80·8	8·44	82
November ..	4	80·6	3·46	76
December ..	9	80·5	3·96	75
Total ..	184	81·3	53·56	78

Type of Disease.—Seventy cases, or 38 per cent. of the total, were septicæmic and 114, or 62 per cent., were bubonic, as against 41 per cent. septicæmic and 59 per cent. bubonic in 1920, thus confirming the observation recorded in the 1920 report that plague in Colombo is becoming more bubonic and proportionately less septicæmic in character.

Relation to Age and Sex.—The same marked preponderance of cases amongst young male adults was as hitherto experienced, the relative incidence being 1·05 per 1,000 for males and 0·28 for females.

(22) *Plague Cases, 1921. At each Age Period.*

Age Period.	No. of Cases.	Age Period.	No. of Cases.
0 to 5 years ..	3	35 years to 40 years ..	16
5 years to 10 years ..	15	40 years to 50 years ..	8
10 years to 15 years ..	29	50 years to 60 years ..	4
15 years to 20 years ..	24	60 years and over ..	3
20 years to 25 years ..	33		
25 years to 30 years ..	33	All Ages ..	184
30 years to 35 years ..	16		

(23) *Plague Cases, 1921. Distribution by Race, Sex, and Age.*

		0 to 5 Years.	5 to 10 Years.	10 to 15 Years.	15 to 20 Years.	20 to 25 Years.	25 to 30 Years.	30 to 35 Years.	35 to 40 Years.	40 to 50 Years.	50 to 60 Years.	60 and over.	All Ages.	Total of each Race.	Case rate per 1,000 Population.	Deaths.	Case Mortality per Cent.	Mortality per 1,000 Population.
All Races ..	Males ..	1	11	24	22	31	30	13	15	6	3	1	57*	184	0·75	170	92·4	0·70
	Females ..	2	4	5	2	2	3	3	1	2	1	2	27†					
Europeans ..	Males ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Females ..	—	—	—	—	—	—	—	—	—	—	—	—					
Burghers ..	Males ..	—	—	—	—	—	—	—	1	—	—	—	1	1	0·07	1	100·0	0·07
	Females ..	—	—	—	—	—	—	—	—	—	—	—	—					
Sinhalese ..	Males ..	1	10	12	5	8	5	1	1	1	1	—	45	58	0·81	53	91·3	0·46
	Females ..	1	3	3	1	—	1	2	—	1	—	1	13					
Tamils ..	Males ..	—	1	5	7	10	10	7	5	3	1	—	49	58	1·05	53	91·3	0·97
	Females ..	1	—	1	—	2	2	1	—	—	1	1	9					
Moors ..	Males ..	—	—	7	8	9	11	3	7	1	1	1	48	52	1·30	50	96·2	1·25
	Females ..	—	1	1	1	—	—	—	1	—	—	—	4					
Malays ..	Males ..	—	—	—	—	—	—	—	—	—	—	—	—	1	0·17	1	100·0	0·17
	Females ..	—	—	—	—	—	—	—	—	1	—	—	1					
Others ..	Males ..	—	—	—	2	4	4	1	2	1	—	—	14	14	1·27	12	85·8	1·08
	Females ..	—	—	—	—	—	—	—	—	—	—	—	—					

* 1·05 per 1,000 males. † 0·28 per 1,000 females.

Local Incidence.—As the accompanying spot map shows, the chief centre of infection was, as usual, in the Sea street, Pettah area, where the disease must now be regarded as endemic. There was a small outbreak in the neighbourhood of the Maradana bazaar, but elsewhere in the town the distribution of cases was distinctly sporadic.

In this connection attention is invited to Dr. Hirst's very interesting report annexed.

(24) *Plague, 1921. Distribution by Wards.*

Ward.	Cases.	Deaths.	Ward.	Cases.	Deaths.
Fort ..	1	—	Slave Island ..	17	16
Pettah ..	23	22	Kollupitiya ..	6	5
San Sebastian ..	11	11	Wellawatta ..	—	—
St. Paul's ..	46	43	Vagrants and unknown	18	15
Kotahena ..	11	10			
New Bazaar ..	13	13	Total ..	184	170
Maradana ..	38	35			

The Fumigation.—The " bag " of thirty-two rats shown in the photograph was obtained as the result of one fumigation lasting 20 minutes from a drain 44 feet long 7½ inches wide and 8 inches high, which ran under the dry fish boutique shown in the upper photograph.

Rat Plague.—Out of a total of 33,050 rats examined at the Laboratory, 67 were proved by bacteriological examination to be plague infected, representing an infection rate of 0·20 per cent., as compared with an infection rate of 0·66 per cent. in 1920. 195 mummified and 331 comparatively recently dead rats were found, a large proportion of which were from known infected localities ; the corresponding figures for 1920 were 78 mummified and 110 recently dead rats.

Preventive Measures.—The preventive measures which were initiated in December, 1920, an account of which was given in section 13 (*h*) of the report for that year, were continued throughout the year 1921, the additional work entailed thereby being much facilitated by the importation of five new Clayton fumigators, and the appointment of additional staff, including one Inspector, five overseers, and five coolies, making a total now employed specially on plague work of one Inspector, six overseers, nine masons, thirty-six coolies, and one carter.

Segregation.—Following on the lines suggested by the Special Committee in their report dated February 28, 1921, a certain amount of relaxation was allowed in the matter of removal of patients to hospitals, and of contacts to the segregation camp (619 contacts were so removed).

Rat Destruction.—The grand total of rats accounted for during the year was 163,281, as against a corresponding total of 109,874 during the previous year, the details of which are as follows :—

(25) *Rat Destruction.*

	1920.	1921.
Trapped	106,833 ..	157,709
Killed by Claytons	2,828 ..	5,046
Found dead	135 ..	331
Mummified	78 ..	195
Total ..	109,874	163,281

Increase in 1921 = 53,407.

(26) *Statement compiled from the Monthly Returns furnished by the Veterinary Surgeon showing the Number of Rats trapped and found dead.*

Month.	No. of Rats trapped.	No. of Rats found dead.	Total.
January	11,558 ..	6 ..	11,564
February	10,477 ..	6 ..	10,483
March	10,095 ..	2 ..	10,097
April	11,101 ..	1 ..	11,102
May	11,793 ..	2 ..	11,795
June	13,808 ..	5 ..	13,813
July	15,061 ..	2 ..	15,063
August	14,712 ..	13 ..	14,725
September	14,453 ..	15 ..	14,468
October	14,877 ..	11 ..	14,888
November	14,898 ..	6 ..	14,904
December	14,876 ..	12 ..	4,888
Total ..	157,709	81	157,790

(27) *Rat Examinations at the Municipal Laboratory, 1921.*

Month.	No. of Rats Examined.	No. found Infected.	Percentage Infection.
January	2,881	18	0·62
February	3,220	12	0·37
March	2,288	12	0·52
April	2,002	—	—
May	2,323	—	—
June	1,993	—	—
July	3,453	5	0·14
August	3,056	3	0·10
September	3,093	2	0·06
October	3,115	5	0·16
November	3,416	7	0·20
December	2,250	2	0·09
Total	33,090	66	0·20

The above does not include one infected rat reported by the Government Bacteriologist, and 195 mummified rats which were found in the infected localities.

The following statement shows the details of the work done by the Special Plague Staff :—

(28) *Work done each Month by Special Plague Staff during 1921.*

Month.	Rats trapped (Veterinary Surgeon).	Rats killed (by Clayton).	Mummified Rats (Plague Inspector).	Dead Rats (Veterinary Surgeon).	Recently dead Rats (Plague Inspector).	Total.
January	11,558	351	12	6	24	11,951
February	10,477	412	—	6	27	10,922
March	10,095	251	—	2	25	10,373
April	11,101	452	6	1	8	11,568
May	11,793	460	3	2	5	12,263
June	13,808	303	1	5	6	14,123
July	15,061	457	10	2	17	15,547
August	14,712	382	9	13	10	15,126
September	14,453	566	14	15	24	15,072
October	14,877	422	49	11	73	15,432
November	14,898	670	79	6	23	15,676
December	14,876	320	12	12	8	15,228
Total	157,709	5,046	195	81	250	163,281

(29) *Work done in each Ward by Special Staff during 1921.*

Ward.	No. of Premises Claytonized.	No. of Rats-holes filled up.	Rats killed by Clayton.	Recently dead Rats.	Mummified Rats.	Rat-nests.	No. of Cart-loads of Rubbish removed by Plague Staff.
Pettah	1,211	5,844	1,485	103	136	18	208
St. Paul's	970	3,528	428	39	21	11	166
San Sebastian	386	1,871	242	14	11	7	148
Slave Island	2,515	10,452	712	21	15	9	260
New Bazaar	284	1,280	172	2	—	—	46
Maradana South	3,308	11,522	950	17	6	13	278
Maradana North	389	7,679	79	3	2	—	94
Kotahena South	448	1,623	163	5	2	1	87
Kotahena North	230	995	185	7	1	—	106
Kollupitiya East	23	123	20	—	—	—	3
Kollupitiya West	184	702	28	4	—	—	18
Fort	208	949	82	27	—	—	23
Wellawatta	171	673	40	4	—	—	9
Maradana East	661	3,634	480	4	1	—	61
Total	10,988	50,875	5,046	250	195	59	1,507
Corresponding total for 1920	8,932	35,145	2,828	110	78	(No record)	207

Plague in relation to Grain.—Evidence was recorded in section 13 (c) of the report for 1920 to show that a marked increase of grain imports is liable to be associated with an increase of plague cases in the town. The following statement is, therefore, of special interest in that it shows that, although there was a very great increase of grain imports during the months of May, June, July, and August, 1921, there was no associated increase of plague, notwithstanding the fact recorded by Mr. Bamford that the meteorological conditions during August and October were very favourable to an increase of plague. This,

therefore, would appear to lend still further support to the previously expressed opinion that the special plague measures introduced in December, 1920, were instrumental in keeping this disease in check during 1921.

(30) *Imports of Grain other than Rice.*

Month.	1916.	1917.	1918.	1919.	Average prior to Rice trouble.	1919.	1920.	1921.
January ..	41,377..	19,291..	34,666..	20,096..	28,853..	— ..	153,315..	26,740
February ..	25,238..	30,910..	25,828..	21,174..	25,788..	— ..	182,040..	24,501
March ..	18,360..	25,497..	20,109..	23,853..	21,955..	— ..	32,451..	21,977
April ..	31,695..	32,973..	20,041..	31,949..	29,165..	— ..	22,474..	30,692
May ..	22,815..	26,311..	31,349..	15,322..	23,949..	— ..	22,705..	*300,825
June ..	29,349..	26,370..	8,722..	31,828..	24,067..	— ..	51.118..	*54,747
July ..	27,654..	21,945..	41,174..	— ..	30,258..	61,053..	71,374..	*105,185
August ..	20,605..	21,349..	24,253..	— ..	22,069..	146,903..	58,836..	*96,920
September ..	49,291..	28,339..	19,782..	— ..	32,471..	57,350..	72,363..	18,463
October ..	33,345..	55,613..	17,914..	— ..	35,624..	136,514..	80,721..	16,325
November ..	45,548..	22,831..	12,741..	— ..	27,040..	43,216..	82,592..	13,601
December ..	30,514..	9,009..	16,954..	— ..	18,826..	92,478..	48,831..	15,674
Total ..	375,791	320,438	273,533	144,222	—	537,514	878,820	725,650
Monthly Average ..	31,316	26,703	22,794	24,037	—	89,586	73,235	60,471

* Marked increase of imports.

Municipal Model Rat-proof Grain Boutiques.—The conditions under which the grain trade is carried on in Colombo were vastly improved by the erection of the Chalmers Granaries and the Manning Market ; but practically no improvement has yet been effected in the matter of the petty grain trade which is carried on in boutiques and small stores all over the town. These boutiques provide an unfailing source of attraction to rats, as the large captures of these pests and the recurrence of plague in such situations, *e.g.*, at Maradana bazaar, clearly shows. An important step in dealing with this aspect of the plague problem was, therefore, taken when the Council decided during the year to erect a number of model rat-proof boutiques on the Municipal land at Gasworks street, the erection of which was commenced during the year and will, it is expected, be completed during 1922.

13.—Smallpox.

Town cases 12 ; Port cases, 3 ; total 15 ; total deaths, 4. The outbreak of smallpox, which began with a concealed case imported from India during August, 1920, and which was responsible for the occurrence of 70 further cases during that year, came to an end on February 4, 1921, when the last case of the outbreak was removed to the Infectious Diseases Hospital, this being the eleventh case to occur during 1921. The total number of cases during this outbreak from its commencement in August, 1920, until its end in February, 1921, was thus 82.

One further case, also imported from India, occurred during April, 1921, after which no further case occurred during the year. The total for the year 1921 was thus 12 cases.

14.—Vaccination.

6,162 primary and 1,286 re-vaccinations were performed during the year. This is a decided falling off in the matter of primary vaccinations compared with 1920, as the following shows :—

(31) *Births and Vaccinations.*

Year.	Births.	Primary Vaccinations.	Deficit of Primary Vaccinations compared with Births.
1920	7,197 ..	7,159 ..	38
1921	8,724 ..	6,162 ..	2,562

The following statement shows the details of vaccination during 1921 :—

(32) *Vaccinations performed during 1921.*

(*a*) By Government Vaccinators.

Ward.	Primary Vaccination.	Re-vaccination	Total.
Fort, Galle Face, Pettah, and San Sebastian	511 ..	164 ..	675
St. Paul's	707 ..	109 ..	816
Kotahena	1,098 ..	26 ..	1,124
New Bazaar	710 ..	71 ..	781
Maradana	651 ..	151 ..	802
Slave Island	606 ..	23 ..	629
Kollupitiya	810 ..	57 ..	867
Wellawatta	771 ..	28 ..	799
Itinerating (Colombo) ..	258 ..	33 ..	291
Total ..	6,122	662	6,784

(*b*) By Municipal Vaccniators.

Ward.	Primary Vaccination.	Re-vaccination.	Total.
Pettah	2 ..	160 ..	162
New Bazaar	2 ..	46 ..	48
Slave Island	36 ..	418 ..	454
Total ..	40	624	664

Total Vaccinations in Colombo.

Primary	6,162
Re-vaccination	1,286
Total ..	7,448

15.—Chickenpox.

This disease was very prevalent during the year, 773 cases, including 711 from the town, 6 from the port, and 56 from extra-urban districts, being reported. Two deaths were ascribed to this cause during the year ; but one of these was returned as debility following chickenpox, in an old man seventy years of age. The other was a child two years of age, in regard to which particulars are not recorded.

16.—Measles.

This disease, which normally assumes epidemic proportions at intervals of from two and a half to three years, and was not due until the middle of 1920 or early in 1921, broke out in severe epidemic form in July, 1919, about a year or more ahead of its time (for explanation see report for 1919) and reached its maximum in March, 1920, during which year 1,062 town cases were reported. It began to subside in April, 1920, and remained low throughout the remainder of that year and the whole of 1921, during which year only 190 town, 4 port, and 13 extra-urban cases were reported. No deaths were ascribed to this cause during the year.

17.—Beri-beri.

Three fatal cases of Beri-beri, landed from ships in the harbour, were recorded.

Part II.—Administration.

18.—General Sanitary Work.

The details of the general sanitary work carried out during the year in each ward by the outdoor staff of the Department are given in statements 34 and 35. A great increase in the amount ofwork done, compared with the previous year, is recorded under most of the headings, the most marked increase being in connection with plague prevention. Thus, the number of private premises cleansed by the staff of the Public Health Department rose from 1,651 in 1920 to 4,095 in 1921 ; the number of dwellings pesterined increased from 2,873 to 9,233 ; the number of dwellings claytonized from 8,932 to 10,922 ; the number of dwellings unroofed from 2,291 to 9,020 ; rat-holes claytonized and filled up increased from 35,145 to 44,636 ; buildings limewashed after notice or verbal warning from 6,066 to 11,876.

18.—Prosecutions.

The number of prosecutions increased from 2,119 in 1920 to 2,889 in 1921, and convictions from 1,986 to 2,517. The average fine has, however, steadily fallen from Rs. 13·87 per conviction in 1916 to Rs. 5·95 per conviction in 1921 as the following shows :—

(33) *Convictions and Fines.*

Year.	Convictions.	Total Fines. Rs. c.	Average Fine. Rs. c.
1914	1,878 ..	25,551 35 ..	13 60
1915	1,774 ..	24,013 50 ..	13 53
1916	2,246 ..	31,157 0 ..	13 87
1917	1,777 ..	22,307 50 ..	12 55
1918	1,349* ..	12,819 0 ..	9 50
1919	1,745 ..	15,498 70 ..	8 88
1920	1,986 ..	15,035 75 ..	7 57
1921	2,517 ..	14,978 25 ..	5 95

* Influenza year.

As the foregoing statement shows the number of offences against the sanitary laws tends to increase *pari passu* with the decrease in the amount of the fines. In other words, inadequate punishment not only encourages neglect of the sanitary regulations and so endangers the health of the general population, but it inevitably entails more work to all concerned, including the staff of the Public Health Department and the Magistrate himself.

(34) *Work done by Ward Inspectors during 1921.*

Nature of Work.	Fort.	Pettah.	San Sebastian.	St. Paul's.	Kotahena North.	Kotahena South.	New Bazaar.	Maradana North.	Maradana South.	Maradana East.	Slave Island.	Kollupitiya.	Wellawatta North.	Wellawatta South.	Total.
1. Number of inspections ..	2,694	3,701	3,199	4,702	4,949	3,724	3,957	3,469	6,001	2,644	2,370	4,453	3,457	6,854	56,174
2. Number of premises in which sanitary defects were found (*a*) non-structural	65	235	194	482	313	319	477	478	170	451	177	569	292	331	4,553
3. Number of premises in which sanitary defects were found (*b*) structural ..	8	29	128	200	75	130	25	202	90	136	67	89	136	—	1,315
4. Number of premises where non-structural defects were rectified ..	37	166	163	215	108	245	423	397	45	435	21	242	165	273	2,935
5. Number of premises where structural defects were rectified ..	3	33	40	38	22	51	13	151	13	15	79	26	33	—	517
6. Number of insanitary dwellings structurally improved ..	3	—	9	12	1	4	10	16	16	61	9	29	5	—	175
7. Number of buildings other than dwellings structurally improved ..	—	33	88	70	20	64	2	40	15	91	13	46	20	—	502
8. Number of insanitary dwellings closed under Plague Regulations ..	—	—	—	6	—	—	—	—	—	—	—	—	—	—	6
9. Number of insanitary dwellings remaining closed at end of year (total) .	—	1	8	51	52	—	—	22	1	—	—	—	—	—	135
10. Number of insanitary dwellings demolished	—	—	—	—	2	—	—	9	—	—	—	—	—	—	11
11. Number of insanitary premises in which plans have been called for ..	22	—	—	—	—	—	—	—	—	—	2	—	—	—	24
12. Number of insanitary dwellings included in 11	40	—	—	—	—	—	—	—	—	—	4	—	—	—	44
13. Number of insanitary premises in which plans have been received ..	2	—	—	—	—	—	—	—	—	—	1	9	—	—	12
14. Number of insanitary premises condemned and referred to Works Engineer for improvement	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15. Number of insanitary dwellings included in 14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16. Number of premises scavenged by the Public Health Department Cleansing Gang	90	114	30	99	419	589	126	782	480	710	296	101	101	158	4,095
17. Number of dwellings pesterined ..	203	697	258	630	222	431	271	341	2,734	2,066	889	184	137	170	9,233
18. Number of dwellings claytonized ..	203	1,209	386	970	230	448	284	386	3,304	2,161	904	198	138	171	10,992
19. Number of dwellings unroofed ..	203	133	377	350	230	438	271	373	3,104	2,161	902	170	137	171	9,020
20. Number of rat holes found, claytonized, and filled up ..	784	5,944	1,871	3,528	995	1,623	1,280	1,348	11,457	9,242	4,583	901	407	673	44,636

(34) *Work done by Ward Inspectors during 1921*—contd.

Nature of Work.	Fort.	Pettah.	San Sebastian.	St. Paul's.	Kotahena North.	Kotahena South.	New Bazaar.	Maradana North.	Maradana South.	Maradana East.	Slave Island.	Kollupitiya.	Wellawatta North.	Wellawatta South.	Total.
21. Number of dwellings disinfected ..	17	531	232	478	157	221	110	251	974	145	154	84	81	146	3,581
22. Number of dwellings limewashed ..	63	267	1,262	3,487	94	468	1,211	1,273	365	1,275	889	537	535	150	11,876
23. Number of wells filled up ..	—	—	—	—	2	—	—	2	—	—	—	7	1	3	15
24. Number of cesspits filled up ..	—	4	16	52	11	15	30	56	2	2	1	1	11	12	213
25. Number of notices served under section 1, sub-section (1), of Ordinance No. 15 of 1862. (Filthy premises) ..	10	36	77	165	24	95	88	225	84	83	51	62	46	41	1,087
26. Number of notices served under section 186 of Ordinance No. 6 of 1910. (Privy accommodation) ..	—	—	—	—	4	3	—	8	—	7	—	—	6	2	30
27. Number of notices served under section 189 of Ordinance No. 6 of 1910. (Filling up of stagnant pools, &c.) ..	—	—	20	—	21	1	—	5	1	—	—	—	1	1	50
28. Number of notices served under section 178 of Ordinance No. 6 of 1910. (Cleansing and limewashing) ..	9	44	76	143	48	42	74	377	60	76	126	100	101	104	1,380
29. Number of notices served under section 49, Part I. of Plague Regulations. (Closure of buildings unfit for human habitation) ..	—	—	—	4	—	—	—	—	—	—	—	—	—	—	4
30. Number of notices served under By-law 8 (1), chapter XXII. (Improvement to buildings unfit for human habitation)	2	—	—	6	—	—	1	—	—	1	—	—	1	—	11
31. Number of notices served under section 38, Part I. of Plague Regulations. (Filling up of wells) ..	—	—	—	—	—	—	—	4	5	—	—	—	2	—	11
32. Number of notices served under section 39, Part I. of Plague Regulations (Over-crowding)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33. Number of prosecutions ..	38	267	191	328	180	197	294	230	190	237	245	263	126	103	2,889
34. Number of convictions ..	37	235	179	265	156	165	245	190	179	245	199	250	79	93	2,517
35. Number of cases acquitted, withdrawn, or otherwise dealt with ..	1	20	11	57	15	22	36	27	10	3	29	16	10	3	260
36. Number of cases pending at end of year	—	6	1	8	1	—	3	8	—	4	5	2	—	4	42
	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.
37. Amount of fines	428 50	1,139 0	735 50	1,985 50	669 50	834 50	940 0	1,022 50	834 75	1,748 50	1,284 50	1,814 0	721 0	820 50	14,978 25

(35) *Prosecutions : Details.*

	No. of Cases.	No. of Convictions.
Section 1, sub-section (1), of Ordinance No. 15 of 1862 : Filthy premises ..	1,015	918
Section 1, sub-section (1), of Ordinance No. 15 of 1862 : Filthy aerated water factory ..	4	4
Section 1, sub-section (1), of Ordinance No. 15 of 1862 : Filthy dairy ..	24	25
Section 1, sub-section (1), of Ordinance No. 15 of 1862 : Filthy laundry ..	13	17
Section 1, sub-section (2), of Ordinance No. 15 of 1862 : Foul privy	15	2
Section 1, sub-section (4), of Ordinance No. 15 of 1862 : Nuisance by cattle, swine, &c...	104	98
Section 1, sub-section (9), of Ordinance No. 15 of 1862 : Selling unwholesome food ..	17	14
Section 1, sub-section (11), of Ordinance No. 15 of 1862 : Storing offensive articles ..	2	2
Section 39 of Ordinance No. 1 of 1896 : Unregistered dairy	16	15
Section 53, chapter III., of Ordinance No. 1 of 1896 : Unregistered laundry ..	30	28
Section 110 of Ordinance No. 6 of 1910 : Spitting in public market	19	15
Section 178 of Ordinance No. 6 of 1910 : Failure to limewash	98	57
Section 186 of Ordinance No. 6 of 1910 : Neglect to provide privy accommodation ..	4	4
Section 189 of Ordinance No. 6 of 1910 : Failure to fill up stagnant pool ..	1	—
Section 190B of Ordinance No. 6 of 1910 : Failure to close cesspit	100	14
Section 194 of Ordinance No. 6 of 1910 : Abuse of roadside by children ..	1	1
Section 205 of Ordinanco No. 6 of 1910 : Neglect to report infectious disease ..	19	17
Section 212 of Ordinance No. 6 of 1910 : Unlicensed offensive trades	8	2
Section 242 of Ordinance No. 6 of 1910 : Unregistered servant in stall ..	3	3
Rule 2 of chapter VIII., by-laws : Burying night soil on premises	1	1
Rule 29 of chapter VIII., by-laws : Digging pits and wells	2	2
Rule 31 of chapter VIII., by-laws : Throwing rubbish on roadside	5	4
Rule 4 of chapter IX., by-laws : Filthy bathing well	10	4
Rule 1 of chapter XI., by-laws : Unregistered eating-house	42	35
Rule 7 of chapter XI., by-laws : Filthy bakery	40	37
Rule 7 of chapter XI., by-laws : Filthy eating-house	87	73
Rule 3 of chapter XI., by-laws : Uncemented eating-house	1	—
Rule 8 of chapter XI., by-laws : Unclean workmen in bakery	8	8
Rule 3 of chapter XIII., by-laws : Misbehaving in public market	44	41
Rule 9 of chapter XIII., by-laws : Unlicensed fish vendor	7	7
Rule 11 of chapter XIII., by-laws : Filthy stall	155	148
Rule 14 of chapter XIII., by-laws : Unauthorized articles in stall	2	2
Rule 23 of chapter XIII., by-laws : Selling unauthorized articles in stall ..	11	4
Rule 28 of chapter XIII., by-laws : Throwing rubbish in market	4	4
Rule 31 of chapter XIII., by-laws : Closing stall without permission	6	6
Rule 34 of chapter XIII., by-laws : Obstruction of passages in public market ..	193	186
Rule 2A of chapter XIV., by-laws : Exposing food to dust and flies	351	338
Rule 3 of chapter XIV., by-laws : Sale of adulterated milk	178	161
Rule 5 of chapter XIV., by-laws : Refusing sample of milk	3	2
Rule 7 of chapter XIV,, by-laws : Unlicensed milk vendor	199	187
Rule 6 of chapter XVII., by-laws : Failure to submit weekly return of burials ..	1	1
Regulation 1 made under section 4 of Ordinance No. 3 of 1897 : Over 25 bags of rice in store	11	6
Regulation 1 made under section 4 of Ordinance No. 3 of 1897 : Storing rice in place not approved by Chairman	35	24
Total ..	2,889	2,517

19.—Steam Disinfection Station.

The following is the record of work carried out at the Equifex steam disinfection station during the year :—

(36) *Work done at Steam Disinfecting Station during 1921.*

Month.	No. of Pieces disinfected.	No. of Loads.
January	1,870	17
February	370	13
March	175	7
April	407	7
May	210	11
June	158	7
July	111	8
August	198	12
September	704	19
October	350	16
November	251	9
December	102	—
Total ..	4,906	126

20.—Mosquito Prevention.

Mosquito Proof Street Gullies.—" When the drainage of Colombo is completed there will be an enormous number of gullies connecting the surface channels with the underground sewers. Each of these gullies will contain water which, in the absence of rainfall or thorough flushing, will, I fear, form favourable breeding places for mosquitoes . . . . I would, therefore, suggest the advisability of referring this point to the Engineers with a view, if possible, of their devising some form of gully which will prevent mosquitoes gaining access to the water in the traps. Unless this is done it is probable that a serious nuisance from mosquitoes may arise." (Report No. 406 of November 8, 1909.)

In accordance with the above suggestion Mr. Cox, the City Sanitation Engineer, designed and had made a mosquito-proof gully, the first example of which was placed at the bottom of Wolfendahl street, in February, 1910. This proved entirely successful, and according to a return kindly furnished by Mr. Blizzard on November 2, 1921, it has been introduced in 233, or 13 per cent. of the total of 1,750 street gullies in the town. An examination of all these proofed gullies, which was carried out in 1921 by the

mosquito staff, showed that 163, or 70 per cent. of them, were entirely free from mosquito larvæ, while 70, or 30 per cent., were infected. Of these latter, 56 were found to be structurally defective, while 14 were blocked with rubbish, so that the mosquito-proofing arrangement could not operate. The City Sanitation Engineer undertook to have all these defective ones put right.

The experience gained during the thirteen years since this question of mosquito-proofing was first raised has amply demonstrated the correctness of the opinion then expressed, the non-proofed gullies having been found, times without number, to be one of the most fruitful sources of mosquito breeding and consequent nuisance in the town.

As Mr. Cox's design has been proved by years of experience to be eminently successful, it is strongly urged that it should be generally adopted here, and that provision should be made for mosquito proofing of the whole of the street gullies in the town. In no other way is it practicable to deal with this source of nuisance and danger to the public health, the cost of effective treatment of these gullies with culicides being prohibitive.

Mosquito nuisance in 1921.—As the result of the abnormal drought during the year 1921, and the consequent lack of proper flushing of gullies, catchpits, drains, canals, &c., mosquitoes were exceptionally prevalent during the year, and were the cause of much complaint from the residents. In addition to this, the town was, as usual, invaded during the north-east monsoon by hosts of migratory mosquitoes (*Culex sitiens, Culex gelidus,* &c.), which for the most part breed in the swamps, both without and within the town. This latter source of nuisance cannot be dealt with by the Public Health Department.

To add to the trouble, autochthonus, or locally acquired malaria, appeared in the town, the investigation into and the carrying out of measures for the prevention of which to a large extent monopolized the time and attention of the mosquito prevention staff, who were, thus, frequently prevented for some time from attending to the householders' complaints, which almost invariably had reference to stegomiya, culex, and other non-malaria carrying species of mosquitoes.

The following statement shows the details of the routine work carried out by the mosquito prevention staff :—

(37) *Anti-Mosquito Work.*

(1) Complaints from Householders.

Number of complaints received	53
Number of premises visited	1,254
Number of potential breeding places found	37,767
Number of actual breeding places found	2,168

(2) General Inspection Works.

Number of premises inspected	96
Number of tenements inspected	399
Number of potential breeding places found	4,924
Number of actual breeding places found	641

(3) Summary.

Number of complaints received	53
Number of premises inspected	1,450
Number of tenements inspected	399
Number of potential breeding places found	42,691
Number of actual breeding places found	2,809

21.—Markets and Food Inspection.

There is no material improvement to record in regard to the state of the public markets, which are for the most part structurally very unsatisfactory. Provision has, however, been included in the 1922 Budget for placing sunshades and hydrants in the larger markets, and for the erection of two new markets at Borella and Kotahena.

The statement below is a record of foodstuffs condemned by the officers of this Department during the year, from which it might be inferred that comparatively little bad food is offered for sale in Colombo. Although this is, I believe, on the whole, correct, it must be borne in mind that inspection of food here is very inadequately provided for. Food inspection obviously cannot be properly carried out in a town of this size unless a special staff is employed for that specific purpose, as is done in nearly all other large towns—even in the East. Colombo is much behind the times in this respect, and a beginning should be made here without delay, as has been repeatedly urged, by the appointment of at least one special Inspector, with a training in Food Inspection.

(38) *Damaged Foodstuffs condemned, 1921.*

	Cwt.	qr.	lb.
Fish	0	1	13
Beef	0	3	14
Mutton	0	0	2
Cheese	0	0	2

Foodstuffs condemned at Customs.

Rice	33 bags and 1 bushel
Potatoes	1,864 bags and 40 cwt.
Sugar	10 bags
Cured fish	130 bags
Dry fish	31 bundles

Foodstuffs condemned at Kochchikadde Warehouse.

Dry fish	19 bags and 2 cwt.

At Chalmer's Granaries.

Rice	269 bags

At Manning Market.

Rice	12 bushels

22.—Dairies and Milk Supply.

In view of the unsatisfactory state of the Colombo milk supply during the previous two years, special attention was directed to this subject during 1921, with the result that a decided improvement was effected. The state of the milk supply is, however, still far from satisfactory, owing chiefly, it is believed, and as was stated in the report for 1920, to the imposition of inadequate penalties in the Municipal Court when transgressors were detected and brought up for punishment.

897 samples of milk were taken by the Sanitary Inspectors to the City Analyst for examination, with the result that 220, or 24·5 per cent., were proved to be adulterated. This, although still very bad, is a decided improvement on the 1920 results, when no less than 209, or 37 per cent., of 563 samples examined were found to be adulterated.

Seventeen dairies were discontinued, while 14 new licenses were issued during the year, leaving 40 dairies on the register at the end of the year, as against 43 at the end of the previous year.

One of the greatest difficulties experienced was, as usual, in dealing with illicit vendors, whom many of the householders still cheerfully continue to patronize and thus encourage, notwithstanding the repeated warnings by the Public Health Department that the risk of acquiring disease has been proved to be far greater in the case of milk supplied by these unlicensed, and therefore unsupervised, milkmen, than is the case with the registered and regularly supervised dairymen. The mere fact that the *blood of every licensed milk vendor is examined bacteriologically* for the detection of enteric carriers before the annual license is granted, whereas none of the illicit vendors are so examined, is in itself a sufficient guarantee of the greater safety ensured by employing only licensed milkmen.

23.—Bakeries.

The state of the bakeries during the year was, on the whole, fairly satisfactory; many of the smaller bakeries, however, show an incorrigible tendency to degenerate, unless constantly kept up to the mark.

Six bakeries were discontinued, and 5 new licenses were issued during the year, leaving 45 on the register at the end of the year, as against 47 at the end of the previous year.

24.—Laundries.

There were 322 registered laundrymen in the town at the beginning of the year. A recent revision showed that there are now only 291, distributed as follows :—

(39) *Laundry Registration.*

Ward.	Number of Laundries.	Wards.	Number of Laundries.
Fort ..	.. —	Maradana East	.. 27
Pettah ..	.. 8	Slave Island ..	.. 18
San Sebastian ..	.. 2	Kollupitiya ..	.. 36
St. Paul's ..	.. 1	Wellawatta North	.. 22
Kotahena North	.. 31	Wellawatta South	.. 29
Kotahena South	.. 16		
New Bazaar ..	.. 37	Total	.. 291
Maradana North	.. 58		
Maradana South	.. 6		

Wekanda Municipal Laundry.—This laundry, which was opened on December 1, 1920, was extended during 1921, the total accommodation now provided being 6 double and 28 single tanks, 30 ironing rooms, 30 soiled linen stores, and 6 drying rooms. The drying rooms which are required during wet weather were completed in October. The total cost to date is Rs. 42,561·18, but a few details have yet to be attended to, the chief of which is the provision of ironing boards, the dhobies having represented that the cement ironing benches were unsatisfactory.

A sum of Rs. 50,000 has been provided in the 1922 Budget for the erection of a similar laundry at Blomendahl. Government granted free sites by the lake side for similar laundries at Polwatta and Vauxhall street, but a certain amount of reclamation has still to be carried out at both of these sites.

The question of the extension of this system to the whole of the town is under consideration at the time of writing.

25.—Eating Houses.

These, for the most part small establishments, are difficult to deal with, owing partly to their great number, wide distribution, and frequent changes of management and address, and partly to the fact that most of them are conducted on lines of the most rigid economy in the matter of fittings, furnishing, and general attention to appearance. The fact is that their customers do not, for the most part, pay the slightest attention to anything, except the quantity and quality of the food supplied and the price thereof, and there is, therefore, little or no encouragement for the proprietor to spend money on embellishing or improving his premises. A good deal has, however, been done at the instance of this Department in the matter of improving the lighting, ventilation, and general cleansing of these places. Ninety-seven registrations were cancelled, and 115 new registrations were granted during the year, leaving 456 on the register at the end of the year, as against 438 at the end of 1920.

26.—Offensive and Dangerous Trades.

(*a*) *Special Areas.*—By a resolution dated September 6, 1921, the Council laid it down as a general policy that " for the present, at least, existing offensive trades which are already established should not be discontinued, unless there is some special reason for so doing, as, for instance, the creation of an intolerable nuisance, but that, in future, new licenses for the offensive and dangerous trades specified in schedule ' A ' should not be issued in respect of buildings in areas other than those declared to be special areas reserved for such trades."

By the same resolution certain areas of the town were declared to be " residential areas," while others were declared to be " special areas " set apart for certain specified offensive trades.

The hitherto often difficult and troublesome question of dealing with applications for licenses for offensive trades was thus greatly simplified, to the relief of the staff and the advantage of both the traders and the public.

The trades thus controlled are (1) plumbago curing, (2) lime burning, (3) brick making, (4) tanning, (5) green hide stores, (6) manure factories and stores, (7) green bone stores, (8) offal and blood boiling, (9) animal fat soap making, (10) animal fat oil boiling.

(*b*) *Copra Storing.*—No provision for dealing with copra stores was included in the Council's resolution, as this trade had not, prior to the appearance of the copra beetle in October, 1916, been regarded as a nuisance. So many complaints were, however, received in regard to the annoyance caused by this insect that it was felt that some general policy was required for the guidance of the staff in dealing with applications for new licenses. The Chairman accordingly approved, on October 1, 1921, the adoption of the following rules governing the granting of licenses to store copra :—

(1) No license shall be granted to store copra within any area which has been declared by the Municipal Council to be a residential area (*vide* resolution of September 6, 1921).

(2) No license shall be granted to store copra in any building which is within 50 feet of a dwelling, bakery, or eating-house ; provided that this rule shall not apply to any area which has been declared by the Municipal Council to be a special area set apart for offensive trades.

The proviso in rule (2) was subsequently (on March 8, 1922) amended by the Chairman so as "freely to permit of the storing of copra within the area bounded by the San Sebastian canal, the Kelaniya river, Victoria Bridge road, Prince of Wales's avenue, Layard's broadway, Armour street, and Skinner's road south as far as the San Sebastian canal.

(*c*) *Aerated Water Factories.*—This trade is by reason of the danger arising from the bursting of bottles included amongst the "offensive and dangerous trades" specified in the by-law published in *Gazette* No. 6,782 of March 3, 1916, and therefore requires a license. Aerated water factories are, on the whole, well conducted, and nothing but water from the town mains is allowed within the premises, which are inspected from time to time, samples of the waters being taken for bacteriological and chemical examination.

There were thirteen aerated water factories in the town during the year, no change in registration having taken place.

The introduction by one factory of the patent crown cork is a decided improvement, from a sanitary point of view, on the glass ball and dimple type of bottle.

27.—Slaughter-house.

A great improvement to the slaughter-house was effected during the year by the connection of the drains from the cattle and slaughter sheds to the sewer, and by the crow-proofing of the slaughter sheds. Provision was included in the 1922 Budget for the laying down of a concrete paving around the outside of the slaughter sheds, with a view of preventing the pollution of the ground, which is at present caused by the washings from the floors of the sheds.

(40) *Slaughter-house Return.*

Number of cattle slaughtered	26,752
Number of sheep and goats slaughtered	56,278
Number of pigs slaughtered	3,004
Number of cattle rejected before slaughter	281
Number of cattle rejected owing to poor condition	270
Number of sheep and goats rejected	—
Number of cattle rejected after slaughter	34
Number of sheep and goats rejected after slaughter	—
Number of pigs rejected after slaughter	—

28.—Maternity and Child Welfare.

The work now being carried on in Colombo in connection with Maternity and Child Welfare falls under three headings, viz., (1) Municipal, (2) Government, and (3) Unofficial.

(1) *Municipal Undertakings.*

(*a*) *Midwives.*—The existing organization for dealing with maternity and child welfare in Colombo had its origin in an investigation, which was carried out during 1903, into the then very heavy infant mortality, the results of which were submitted in report No. 913 of May 17, 1904, in which the employment of a number of trained nurses or *midwives* amongst the poorer classes of the people was recommended. This recommendation, having been adopted by the Council, was given effect to by the appointment of six certificated midwives on May 1, 1905, these midwives being posted for duty in the poorest quarters of St. Paul's, New Bazaar, Kotahena, San Sebastian, and Slave Island Wards ; St. Paul's being allotted two midwives and the other Wards one midwife each.

(*b*) *Dispensaries and Health Visitors.*—The next step resulted from an investigation carried out during 1905-07 into the prevalence of "fevers" in Colombo, the results of which were submitted in report No. 257 of July 28, 1908, in which the establishment in the poorer quarters of the town of a number of Municipal Free Dispensaries with attached Health Visitors was recommended. This recommendation, having been adopted by the Council, was given effect to by the opening of (1) Slave Island Dispensary on February 1, 1910, (2) St. Paul's Dispensary on July 1, 1914, and (3) Maradana Dispensary on November 1, 1919, while a fourth dispensary, to be established in Modera, was sanctioned in 1921, and will be opened in April, 1922. The question of establishing still further dispensaries is under consideration at the time of writing.

Each dispensary was started with a staff of a Medical Officer, an Apothecary, an orderly, and one or more Lady Health Visitors, the midwives previously appointed being in each case attached to the dispensary in their respective divisions.

Including the new dispensary at Modera, for which a staff has already been engaged, the total staff employed by the Council at their four dispensaries is as follows :—4 Medical Officers, 4 Apothecaries, 11 health visitors, 7 midwives, 4 orderlies.

Some idea of the great growth of the maternity and child welfare work since its initiation sixteen years ago may be obtained from the following :—

(41) *Work of Municipal Midwives.*

Year.	No. of Confinements attended.	No. of Children Born.	Total Births in Colombo.
1906	396	405	4,726
1907	476	479	4,280
1908	543	546	4,609
1909	567	571	4,589
1910	631	646	4,819
1911	615	623	5,280
1912	677	690	5,195
1913	661	668	5,693
1914	686	703	5,359
1915	638	653	5,641
1916	666	674	5,552
1917	662	671	5,860
1918	651	656	5,920
1919	560	562	5,907
1920	772	779	7,197
1921	743	749	8,724

As the foregoing statement shows, the Municipal midwives in Colombo have attended, since 1906, between from 1 in 7 and 1 in 11 of the total babies born each year in the town, a record which is, so far as I am aware, unsurpassed by any other Municipality in the East. It will, however, be observed that, although each midwife now attends nearly twice as many births in a year as she did in 1906, the total births in the town has increased so much that the proportion attended by the Municipal midwives is practically the same now as it was sixteen years ago, viz., 1 in 11½. As this work is most important in connection with the reduction of infant mortality, a considerable increase in the number of these trained midwives is desirable, and is therefore recommended.

(42) *Work done by the Municipal Midwives, 1921.*

Number of confinements attended	743
Number of children born	749
Number of stillbirths	23
Number of deaths within two weeks	10
Death-rate, exclusive of stillbirths	1·34 per cent.

Work of Health Visitors.—In addition to visiting 293 expectant mothers and 355 confinement cases during the year, the Health Visitors paid 2,971 visits to hand-fed children, and 12,447 visits at which they gave instructions regarding infant feeding.

The following shows the progressive increase of work by the Health Visitors regarding infant feeding since the first dispensary was opened in 1910 :—

(43) *Infant Feeding.*

Year.	Visits at which Instructions *re* Infant Feeding were given to Mothers.	Visits to Hand-fed Children.	
1910	590	No record	Slave Island only.
1911	1,784	No record	
1912	1,858	609	
1913	2,601	675	
1914	1,661	619	Slave Island and St. Paul's.
1915	777	365	
1916	3,283	865	
1917	3,507	1,775	
1918	3,150	589	
1919	4,552	2,630	Slave Island, St. Paul's, and Maradana.
1920	6,786	1,920	
1921	12,447	2,971	

(44) (*a*) *Statement of Work done at the Slave Island Dispensary, 1921.*

Number of patients treated	12,443
Number of visits by patients	26,214
Daily average attendance	85
Number of outdoor visits paid by the Medical Officer	117
Number of Municipal employees treated	28
Number of confinement cases visited by the Medical Officer	53

Health Visitors.

Number of visits paid to houses	23,535
Number of houses where instructions *re* infant feeding given	3,628
Number of visits to hand fed children	589
Number of labour cases visited	8
Number of dispensary tickets issued	3

(*b*) *Statement of Work done at St. Paul's Dispensary, 1921.*

Number of patients treated	15,446
Number of visits by patients	20,794
Daily average attendance	63
Number of outdoor visits paid by the Medical Officer	217
Number of Municipal employees treated	47
Number of confinement cases visited by the Medical Officer	38

Health Visitors.

Number of visits paid to houses	39,650
Number of houses where instructions *re* infant feeding given ..	5,480
Number of visits to hand fed children	1,370
Number of labour cases visited	236
Number of dispensary tickets issued	64

(*c*) *Statement of Work done at Maradana Dispensary, 1921.*

Number of patients treated	8,614
Number of visits by patients	16,354
Daily average attendance	52
Number of outdoor visits paid by the Medical Officer	125
Number of Municipal employees treated	17
Number of confinement cases visited by the Medical Officer ..	1

Health Visitors.

Number of visits paid to houses	37,587
Number of houses where instructions *re* infant feeding given ..	3,339
Number of visits to hand-fed children	1,012
Number of labour cases visited	21
Number of dispensary tickets issued	3

(2) *Government Undertakings.*

In addition to the maternity and child welfare work carried on by the Municipality, the Government has (*a*) a Lying-in Home with 100 beds, where a clinic is held twice a week for expectant mothers; (*b*) two school Inspecting Medical Officers (1 female) and one school nurse who are engaged in examining school children, and who refer ear, nose, and eye cases to a clinic held twice a week at the Eye Hospital, and tubercular cases to a clinic held twice a week at the King Edward VII. Anti-Tuberculosis Dispensary.

(3) *Unofficial Undertakings.*

So far the only unofficial undertaking which has a direct bearing upon child welfare is the Day Nursery or Crèche established by the Child Welfare Association, which was opened by Lady Manning on November 16, 1921, at Skinner's road south. This work is carried on in a fairly large, airy bungalow, the staff employed being a matron, two ayahs, a cook, a sweeper, and a washerwoman. A medical practitioner gives his services free. Fourteen cots are provided.

One of the chief difficulties encountered in dealing with poorly nourished infants, which has been brought to notice by the Medical Officers and Health Visitors of the dispensaries and also by the Honorary Secretary of the Crèche, is that the parents of these children can seldom afford to carry out the advice given them to feed their children on milk when the mothers cannot breast feed them. They say, and no doubt truly, that they cannot afford to buy milk. There is certainly required here, as an adjunct to the Child Welfare Centres, some arrangement whereby milk—preferably dried milk (*e.g.*, Glaxo) can be issued at cost price, or even free of charge, *under instructions from the Medical Officers.*

29.—Enteric Hospital.

Sixty-five patients were admitted during the year, while there were 11 remaining from the previous year, making a total of 76 treated during the year. Of these, only 45 proved to be enteric fever, 11 were influenza, 9 malaria, 3 pneumonia, 2 tuberculosis, and 6 were other diseases, including one case of plague. Forty-six of the total cases were males and 30 were females. Sixty-nine were discharged cured or relieved, 4 died, *i.e.*, 5·26 per cent., and 3 were remaining at the end of the year. Of the 45 cases of enteric, 39 were cured, 3 died, *i.e.*, 6·6 per cent., and 3 remained at the end of the year. Two of the 3 fatal cases were received in a moribund condition, the other developed pneumonia. The average stay in hospital of the enteric cases was 14·8 days per person.

Eighteen of the enteric cases admitted were sent in by the Sanitary Inspectors, 10 from the General Hospital, 6 from the Police Hospital, 1 from the Lady Havelock Hospital, and 10 sought admission voluntarily.

No patient is now discharged from the hospital until the urine and fæces are reported negative for enteric bacilli by the Municipal Bacteriologist.

(45) *Bacteriological Examination of the Samples sent from the Patients of the Municipal Enteric Hospital during the Year 1921.*

Materials sent for Examination.	To be examined for.	Result of Examination.
39 blood samples ..	Widals reaction ..	38 positive 21 negative
31 urine and fæces samples ..	Typhoid bacilli ..	3 positive 28 negative
4 blood samples ..	Malarial parasites ..	2 positive 2 negative
4 sputum samples ..	Tuberculosis bacilli ..	2 positive 2 negative
1 sputum sample ..	Pneumococci bacilli ..	1 positive
1 pus from bubo ..	B. pastis ..	1 negative
1 spleen and lungs ..	B. pastis ..	1 negative

30.—Closets and Baths.

(*a*) *Private Closets* (City Sanitation Engineer's Report).—The number of premises in the city assessed under ward numbers is stated to be approximately 18,000, of which 1,363 had been drained to the sewers at the end of 1921. This includes the provision of 2,112 water-closets with seats, and 2,593 water-closets with squatting places. 2,242 dry-earth closets have been removed since January 1, 1913. The erection of new dry-earth closets in drained areas is, wherever possible, avoided; but the present cost of sewer connections makes this at times unavoidable.

(*b*) *Public Closets and Baths* (City Sanitation Engineer's Report).—Thirty-seven public closets connected to the sewers had been erected, and were in use at the end of the year. These include a total of 333 squatting places for men, 150 squatting places for women, 166 bathing showers for men, and 75 bathing showers for women.

(*c*) *Cesspits.*—

(46) *Statement of Cesspits.*

Ward.	Number at beginning of Year.	Number closed during Year.	Number remaining.
Fort	—	—	—
Pettah	5	4	1
San Sebastian	155	16	139
St. Paul's	113	52	61
Kotahena North	27	10	17
Kotahena South	49	15	34
New Bazaar	98	48	50
Maradana North	63	56	7
Maradana South	4	3	1
Maradana East	2	2	—
Slave Island	1	1	—
Kollupitiya	2	1	1
Wellawatta North	17	16	1
Wellawatta South	19	12	7
Total	555	236	319

31.—Schools in Colombo.

A list of schools,* public and private, in Colombo, which was made by the Sanitary Inspectors in 1921, disclosed the following :—

(47) *Schools in Colombo.*

	Number of Schools.	Number of Pupils.		
		Boys.	Girls.	Total.
Fort	2	21	20	41
Pettah	1	172	—	172
San Sebastian	8	848	178	1,026
St. Paul's	11	629	583	1,212
Kotahena North	13	995	512	1,507
Kotahena South	18	2,805	1,830	4,635
New Bazaar	7	275	199	474
Maradana North	20	3,513	891	4,404
Maradana South	7	2,450	478	2,928
Maradana East	5	368	242	610
Slave Island	12	894	366	1,260
Kollupitiya	22	2,021	1,964	3,985
Wellawatta North	9	657	725	1,382
Wellawatta South	9	392	380	772
Total	144	16,040	8,368	24,408

English is taught in 87 schools, Sinhalese in 81, and Tamil in 54.

Twenty-seven schools were returned as Anglican, 25 as Roman Catholic, 14 Wesleyan, 2 Baptist, 3 Presbyterian, 17 Buddhist, 2 Hindu, 19 Mohammadan, and 35 undenominational.

The conditions under which many of the smaller private schools are conducted leave much to be desired, especially in the matter of lighting, ventilation, latrine, and washing accommodation. It is very desirable that all these schools should be brought under the control of the Education Department. Some of them bear no resemblance to what is generally understood by the term "school," the master and his pupils being accommodated in what is merely a room in a tenement building, where their presence has only been discovered by the carrying out of house to house inspections by the Sanitary Inspectors. In some of the worst cases pressure has been brought to bear by this Department on the master of the school, so as to secure more commodious and better lighted quarters for his pupils; but specific legal powers, exercised by officers with a special training in such matters, are required for the proper control of these schools.

Maligakande,
March 30, 1922.

W. MARSHALL PHILIP,
Medical Officer of Health.

* Under public schools are included all Government and denominational schools.

Annexure A.

(48) *Births and Deaths, with the Infant Mortality, for each Ward during 1921.*

Ward.	Births.										Deaths.										Infant deaths : Children under one Year of Age.
	Total Births.			Nationality.							Total Deaths.			Nationality.							
	Persons.	Males.	Females.	Europeans.	Burghers.	Sinhalese.	Tamils.	Moors.	Malays.	Others.	Persons.	Males.	Females.	Europeans.	Burghers.	Sinhalese.	Tamils.	Moors.	Malays.	Others.	
Colombo Town ..	8,724	4,470	4,254	83	578	5,378	1,056	1,160	301	168	8,169	4,522	3,647	51	349	4,268	1,597	1,356	256	292	2,098
Fort and Galle Face ..	4	3	1	1	—	—	1	—	1	1	32	27	5	9	—	5	3	1	1	13	1
Pettah	32	18	14	—	—	18	6	—	2	6	79	60	19	2	—	18	30	18	1	10	16
San Sebastian ..	245	134	111	—	5	89	14	120	9	8	282	151	131	—	7	70	36	154	10	5	101
St. Paul's	503	257	246	—	10	129	199	140	4	21	658	356	302	1	10	125	304	191	9	18	230
Kotahena	1,403	724	679	2	89	970	199	101	18	24	1,129	572	557	2	47	719	229	104	14	14	352
New Bazaar ..	636	310	326	2	68	259	47	224	17	19	715	380	335	1	54	239	67	310	18	26	263
Maradana	1,634	885	749	3	123	916	156	323	91	22	1,230	615	615	2	82	640	169	262	50	25	419
Slave Island ..	564	273	291	5	35	229	48	101	110	36	596	300	296	2	27	194	107	121	115	30	203
Kollupitiya.. ..	382	180	202	47	28	209	43	33	10	12	356	181	175	10	23	206	66	34	11	6	84
Wellawatta.. ..	707	370	337	11	65	483	78	52	10	8	370	202	168	1	27	239	68	22	5	8	139
Hospitals, town residents											1,344	806	538	5	47	717	355	111	16	93	
Hospitals, untraced	2,614	1,316	1,298	12	155	2,076	265	66	29	11	248	180	68	—	8	151	66	13	3	7	290
Hospitals, non-resident											1,130	692	438	16	17	945	97	15	3	37	

(49) *Deaths of Males and Females at different Age Periods for each Race in the Colombo Municipality during the Year 1921.*

Age at Death.	Europeans.		Burghers.		Sinhalese.		Tamils.		Moors.		Malays.		Others.		All Races.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Under 1 year of age (see particulars of statement) ..	2	3	44	51	551	491	209	199	218	189	50	45	22	24	1096	1002
Under Five Years :—																
1 year and under 2 ..	2	—	9	14	130	126	37	39	63	46	9	10	3	4	253	239
2 years and under 3 ..	1	—	8	4	94	74	28	18	29	35	5	3	1	2	166	136
3 years and under 4 ..	1	1	4	6	61	49	18	22	9	18	3	6	1	1	97	103
4 years and under 5 ..	2	—	3	1	37	25	13	8	4	7	3	4	1	—	63	45
Over Five Years :—																
5 years and under 10 ..	—	—	11	5	94	78	23	26	13	16	3	12	5	1	149	138
10 years and under 15 ..	—	—	7	2	68	43	14	10	23	18	4	5	3	—	119	78
15 years and under 20 ..	1	—	2	2	83	66	50	29	32	22	2	8	12	3	182	130
20 years and under 25 ..	1	1	8	10	102	122	73	52	39	37	2	2	30	5	255	229
25 years and under 35 ..	5	1	9	11	231	249	157	83	69	59	6	11	73	5	550	419
35 years and under 45 ..	7	—	7	18	214	168	105	55	57	20	6	5	37	5	433	277
45 years and under 55 ..	5	4	22	11	197	132	77	36	34	20	7	5	18	2	360	216
55 years and under 65 ..	9	1	18	19	171	104	62	23	47	20	4	10	11	1	322	178
65 years and under 75 ..	1	1	11	12	110	99	31	26	44	25	5	4	6	4	208	171
75 years and under 85 ..	2	—	6	5	95	93	20	18	36	23	5	3	3	2	167	144
85 years and over ..	—	—	3	6	47	64	14	22	31	41	2	7	5	2	102	142
Total ..	39	12	172	177	2285	1983	931	366	748	608	116	140	231	61	4522	3647
Persons ..	51		349		4,268		1,597		1,356		256		292		8,169	

(50) *Infant Mortality. Deaths at different Age Periods and from Several Causes.*

Cause of Death.	Age.													Race.							
	Age in Weeks.					Age in Months.															
	1	2	3	4	Total.	2	3	4	5	6	7–9	10–12	Total.	Europeans.	Burghers	Sinhalese.	Tamils.	Moors.	Malays.	Others.	All Races.
I.—Developmental Diseases :—																					
(1) Premature birth ..	81	4	1	—	86	—	1	—	—	—	1	—	2	1	5	51	20	5	4	2	88
(2) Atalectasis ..	6	—	—	—	6	—	—	—	—	—	—	—	—	—	—	4	1	1	—	—	6
(3) Atrophy and debility ..	220	50	39	37	346	84	36	24	19	24	33	19	239	—	26	285	118	113	32	11	585
(4) Others	10	2	3	1	16	2	3	—	1	1	2	2	11	1	1	13	7	4	—	1	27
II.—Diseases of Respiratory System :—																					
(1) Laryngitis ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(2) Croup	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(3) Bronchitis ..	3	1	3	2	9	12	9	6	8	8	20	17	80	1	7	35	22	16	7	1	89
(4) Pneumonia ..	4	2	3	8	17	15	19	20	19	28	62	42	205	—	13	131	32	38	6	2	222
(5) Others	1	—	—	—	1	1	—	—	—	—	—	1	2	1	1	1	—	—	—	—	3
III.—Diseases of Digestive System :—																					
(1) Diarrhœal ..	2	—	3	7	12	27	32	18	12	21	55	29	194	—	12	115	26	34	15	4	206
(2) Dentition ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(3) Others	4	5	5	9	23	13	12	5	3	5	6	6	50	—	5	33	21	11	—	3	73
IV.—Diseases of Nervous System :—																					
(1) Convulsions ..	142	48	26	35	251	91	72	34	34	26	60	34	351	—	19	263	128	157	18	17	602
(2) Laryngimus stridulus ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(3) Tetanus ..	6	8	1	—	15	—	—	—	—	—	1	—	1	—	1	7	4	4	—	—	16
(4) Others	2	—	—	—	2	1	—	—	—	—	—	1	2	—	1	2	1	—	—	—	4
V.—Tuberculous Diseases :—																					
(1) Tabes messenterica ..	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	1	—	—	—	—	1
(2) Tubercular meningitis ..	—	—	—	—	—	—	2	1	1	1	2	—	7	—	1	4	1	—	1	—	7
(3) Others	1	—	—	—	1	—	1	2	—	2	3	2	10	—	—	6	3	—	1	1	11
VI.—Accidents :—																					
(1) Injury	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(2) Umbilical hæmorrhage ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(3) Suffocation ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(4) Other violence ..	2	—	1	—	3	—	—	—	—	—	—	—	—	—	—	2	—	1	—	—	3
VII.—Infectious Diseases :—																					
(1) Smallpox ..	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	1	—	1
(2) Chickenpox ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(3) Measles ..	—	—	—	—	—	—	—	1	—	1	—	—	2	—	—	—	1	1	—	—	2
(4) Whooping cough ..	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	1	—	—	—	—	1
(5) Mumps ..	—	—	—	—	—	—	—	—	—	—	2	1	3	—	—	2	1	—	—	—	3
(6) Diphtheria ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(7) Cerebro-spinal fever ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(8) Scarlet fever ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
VIII.—Syphilis	4	1	1	3	9	6	8	1	2	1	5	1	24	—	—	22	5	5	—	1	333
IX.—All other Causes ..	17	2	3	6	28	19	8	7	11	8	21	13	87	1	3	64	17	17	10	3	115
Total ..	505	123	89	108	825	271	203	119	112	127	273	168	1273	5	95	1042	408	407	95	46	2098

(51) *Causes of Deaths registered in Colombo during the Year 1921.*

Causes of Deaths.	Colombo Towns.	Nationality. Europeans.	Burghers.	Sinhalese.	Tamils.	Moors.	Malays.	Others.
All Causes	8,169	51	349	4,268	1,597	1,356	256	292
I.—General Diseases :—								
1.—Epidemic Diseases	978	8	44	452	224	172	28	50
2.—Septic Diseases	73	1	5	39	16	8	2	2
3.—Tuberculous Diseases	766	2	28	444	124	104	26	38
4.—Venereal Diseases	57	—	—	34	13	9	—	1
5.—Cancer or Malignant Diseases	77	2	7	52	12	3	1	—
6.—Other General Diseases	216	2	9	127	40	25	5	8
II.—Diseases of the Nervous System and Organs of Special Sense	961	4	45	435	187	240	26	24
III.—Diseases of the Circulatory System	195	4	14	96	36	28	4	13
IV.—Diseases of the Respiratory System	1,252	9	59	624	259	201	39	61
V.—Diseases of the Digestive System	1,212	5	46	690	241	161	36	33
VI.—Non-venereal Diseases of the Genito-Urinary System and Annexa	301	2	13	159	61	49	10	7
VII.—The Puerperal State	184	—	7	87	36	39	9	6
VIII.—Diseasos of the Skin and of the Cellular Tissue	108	1	2	71	17	12	2	3
IX.—Diseases of the Bones and of the Organs of Locomotion	6	—	2	—	3	—	—	1
X.—Malformations	9	1	2	4	2	—	—	—
XI.—Diseases of Early Infancy	627	3	31	310	141	99	27	16
XII.—Old Age	455	1	15	234	73	99	19	14
XIII.—Affections produced by External Causes :—								
1.—Suicide	11	—	1	7	2	1	—	—
2.—Homicide	5	—	—	5	—	—	—	—
3.—Judicial Hanging or Execution	17	—	—	16	1	—	—	—
4.—Accident and other External Violence	114	5	2	66	25	8	2	6
XIV.—Ill-defined Diseases	545	1	17	316	84	98	20	9

I.—General Diseases.

Epidemic Diseases. 1.—Enteric Fever	219	4	18	144	19	20	2	12
2.—Typhus Fever	—	—	—	—	—	—	—	—
3.—Relapsing Fever	2	—	—	2	—	—	—	—
4. (*a*) Malaria	85	2	5	35	19	13	2	9
4. (*b*) Malaria Cachexia	27	—	—	12	6	6	1	2
5.—Smallpox (*a*) Vaccinated	—	—	—	—	—	—	—	—
5.—Smallpox (*b*) Not Vaccinated	—	—	—	—	—	—	—	—
5.—Smallpox (*c*) Doubtful	4	—	—	2	1	—	1	—
6.—Measles	—	—	—	—	—	—	—	—
7.—Scarlet Fever	—	—	—	—	—	—	—	—
8.—Whooping Cough	7	—	1	3	1	2	—	—
9. (*a*) Diphtheria	5	—	—	3	2	—	—	—
9. (*b*) Membranous Laryngitis	—	—	—	—	—	—	—	—
9. (*c*) Croup	—	—	—	—	—	—	—	—
10.—Influenza	191	—	5	74	48	42	15	7
11.—Miliary Fever	—	—	—	—	—	—	—	—
12.—Asiatic Cholera	—	—	—	—	—	—	—	—
13.—Cholera Nostras	—	—	—	—	—	—	—	—
14. (*a*) Amœbic Dysentery	1	—	—	1	—	—	—	—
14. (*b*) Bacillary Dysentery	—	—	—	—	—	—	—	—
14. (*c*) Dysentery (type not distinguished)	247	1	11	123	66	32	5	9
15.—Plague	176	1	1	49	58	54	2	11
16.—Yellow Fever	—	—	—	—	—	—	—	—
17.—Leprosy	2	—	—	—	—	2	—	—
18.—Erysipelas	8	—	2	3	2	1	—	—
19. (*a*) Mumps	2	—	—	1	1	—	—	—
19. (*b*) Varicella (Chickenpox)	2	—	1	—	1	—	—	—
19. (*c*) Other Epidemic Diseases	—	—	—	—	—	—	—	—
Septic Diseases 20. (*a*) Pyæmia	8	—	1	5	1	1	—	—
20. (*b*) Septicæmia	65	1	4	34	15	7	2	2
20. (*c*) Vaccinia	—	—	—	—	—	—	—	—
21.—Glanders	—	—	—	—	—	—	—	—
22.—Anthrax	—	—	—	—	—	—	—	—
23.—Rabies, Hydrophobia	2	—	1	—	1	—	—	—
24.—Tetanus	58	—	1	29	13	10	1	4
25.—Mycoses	—	—	—	—	—	—	—	—
26.—Pellagra	—	—	—	—	—	—	—	—
27.—Beri-Beri	3	—	—	—	—	—	—	3
Tuberculous Diseases. 28. (*a*) Acute Pulmonary Tuberculosis	733	1	27	421	118	104	25	37
28. (*b*) Chronic Pulmonary Tuberculosis	—	—	—	—	—	—	—	—
29.—Acute Miliary Tuberculosis	4	—	—	1	2	—	1	—
30.—Tuberculous Meningitis	4	—	—	4	—	—	—	—
31.—Abdominal Tuberculosis	6	—	—	4	2	—	—	—
32.—Tuberculosis of the Spine	—	—	—	—	—	—	—	—
33.—Tuberculosis of Joints	1	—	—	1	—	—	—	—
34.—Tuberculosis of other Organs (Lymphatism excepted)	18	1	1	13	2	—	—	1
35.—Disseminated Tuberculosis	—	—	—	—	—	—	—	—
36.—Rickets	89	—	4	61	15	6	2	1
37.—Syphilis	54	—	—	31	13	9	—	1
37*a*—Parangi (Frambœsia Tropicum, Yaws)	3	—	—	2	—	—	1	—
38.—Gonococcus Infection	3	—	—	3	—	—	—	—

(51) *Causes of Deaths, &c.*—contd.

Causes of Deaths.	Colombo Town.	Nationality. Europeans.	Burghers.	Sinhalese.	Tamils.	Moors.	Malays.	Others.
Cancer or Malignant Diseases.								
39.—Cancer and other malignant Tumours of the Buccal Cavity	23	—	1	15	4	3	—	—
40.—Cancer and other malignant Tumours of the Stomach, Liver	6	1	—	2	3	—	—	—
41.—Cancer and other malignant Tumours of the Peritoneum, Intestines, Rectum	9	1	—	8	—	—	—	—
42.—Cancer and other malignant Tumours of the Female Genital Organs	10	—	—	9	1	—	—	—
43.—Cancer and other malignant Tumours of the Breast	4	—	1	2	—	—	1	—
44.—Cancer and other malignant Tumours of the Skin	—	—	—	—	—	—	—	—
45.—Cancer and other malignant Tumours of other Organs or of Organs not specified	25	—	5	16	4	—	—	—
46.—Other Tumours (Tumours of the Female Genital Organs excepted)	9	—	2	4	1	2	—	—
47.—Acute Rheumatic Fever	1	1	—	—	—	—	—	—
48. (*a*) Rheumatoid Arthritis	1	—	—	1	—	—	—	—
48. (*b*) Osteo-Arthritis	—	—	—	—	—	—	—	—
48. (*c*) Chronic Rheumatism	8	—	—	4	2	2	—	—
48. (*d*) Gout	—	—	—	—	—	—	—	—
49.—Scurvy	—	—	—	—	—	—	—	—
50.—Diabetes (Mellitus)	32	1	1	21	5	3	1	—
51.—Exophthalmic Goitre	—	—	—	—	—	—	—	—
52.—Addison's Disease	—	—	—	—	—	—	—	—
53. (*a*) Leucocythæmia	—	—	—	—	—	—	—	—
53. (*b*) Lymphadenoma	1	—	—	1	—	—	—	—
54. (*a*) Anæmia	8	—	—	4	3	1	—	—
54. (*b*) Chlorosis	—	—	—	—	—	—	—	—
55. (*a*) Diabetes Insipidus	—	—	—	—	—	—	—	—
55. (*b*) Purpura	—	—	—	—	—	—	—	—
55. (*c*) Hæmophildia	—	—	—	—	—	—	—	—
55. (*d*) Other General Diseases	—	—	—	—	—	—	—	—
56.—Alcoholism (acute or chroric)	—	—	—	—	—	—	—	—
57.—Chronic Lead Poisoning	—	—	—	—	—	—	—	—
58.—Other Chronic Poisonings (occupational)	—	—	—	—	—	—	—	—
59.—Other Chronic Poisonings (non-occupational)	1	—	—	—	—	1	—	—
II.—Diseases of the Nervous System and of the Organs of Special Sense.								
60.—Eucephalitis	5	—	—	2	3	—	—	—
61. (*a*) Simple Meningitis	35	1	2	19	8	3	1	1
61. (*b*) Cerebro-Spinal Fever	—	—	—	—	—	—	—	—
61. (*c*) Septic Meningitis from various causes	—	—	—	—	—	—	—	—
62.—Locomotor Ataxia	—	—	—	—	—	—	—	—
63.—Other Diseases of the Spinal Cord	5	1	1	1	1	1	—	—
64.—Cerebral Hæmorrhage, Apoplexy	49	—	5	20	5	15	2	2
65.—Softening of the Brain	2	—	—	—	1	1	—	—
66.—Paralysis without specified cause	108	—	12	56	11	26	2	1
67.—General Paralysis of the Insane	—	—	—	—	—	—	—	—
68.—Other forms of mental alienation	3	1	—	2	—	—	—	—
69.—Epilepsy	17	—	—	7	5	4	1	—
70.—Convulsions (non-puerperal)	128	1	6	59	24	33	2	3
71.—Convulsions of Infants	602	—	19	263	128	157	18	17
72.—Chorea	—	—	—	—	—	—	—	—
73.—Neuralgia and Neuritis	—	—	—	—	—	—	—	—
74.—Other Diseases of the Nervous System	6	—	—	5	1	—	—	—
75.—Diseases of the Eyes and their Annexa	—	—	—	—	—	—	—	—
76. (*a*) Mastoid Disease	—	—	—	—	—	—	—	—
76. (*b*) Other Diseases of the Ears	1	—	—	1	—	—	—	—
III.—Diseases of the Circulatory System.								
77.—Pericarditis	3	—	1	1	—	—	—	1
78. (*a*) Simple Acute Endocarditis	6	1	1	3	—	—	—	1
78. (*b*) Infective Endocarditis	1	—	—	—	1	—	—	—
79. (*a*) Myocarditis	2	—	—	—	2	—	—	—
79. (*b*) Valvular Disease	22	—	1	11	6	2	—	2
79. (*c*) Other Organic Diseases of the Heart	103	2	5	48	21	19	2	6
80.—Angina Pectoris	12	—	2	5	—	5	—	—
81. (*a*) Aneurism	6	—	—	4	1	—	—	1
81. (*b*) Atheroma, Arteriosclerosis	1	—	1	—	—	—	—	—
81. (*c*) Other Diseases of the Arteries	—	—	—	—	—	—	—	—
82. (*a*) Cerebral Embolism and Thrombosis	10	1	1	6	1	1	—	—
82. (*b*) Embolism and Thrombosis other than Cerebral	7	—	1	5	—	1	—	—
83. (*a*) Phlebitis	—	—	—	—	—	—	—	—
83. (*b*) Varicose Veins	—	—	—	—	—	—	—	—
83. (*c*) Hæmorrhoids	5	—	1	2	1	—	1	—
83. (*d*) Other Diseases of the Veins	—	—	—	—	—	—	—	—
84. (*a*) Lymphatism, Status Lymphaticus	1	—	—	1	—	—	—	—
84. (*b*) Elephantiasis Arabum (Filariasis)	—	—	—	—	—	—	—	—
84. (*c*) Other Diseases of the Lymphatic System	1	—	—	1	—	—	—	—

(51) *Causes of Deaths, &c.*—contd.

Causes of Deaths.	Colombo Town.	Nationality. Europeans.	Burghers.	Sinhalese.	Tamils.	Moors.	Malays.	Others.
85. (*a*) Hæmorrhage from any part	10	—	—	7	1	—	—	2
85. (*b*) Other Diseases of the Circulatory System	5	—	—	2	2	—	1	—
IV.—Diseases of the Respiratory System.								
86.—Diseases of the Nose	—	—	—	—	—	—	—	—
87. (*a*) Laryngismus Stridulus	1	—	—	1	—	—	—	—
87. (*b*) All forms of Laryngitis (Diphtheritic excepted)	5	1	—	2	1	—	—	1
87. (*c*) Other Diseases of the Larynx	—	—	—	—	—	—	—	—
88.—Diseases of the Thyroid Body	—	—	—	—	—	—	—	—
89.—Acute Bronchitis	145	1	10	57	32	36	8	1
90. (*a*) Chronic Bronchitis	38	—	2	14	11	10	1	—
90. (*b*) Bronchiectasi	2	1	—	—	—	—	—	1
91.—Broncho-Pneumonia	504	1	25	284	82	85	10	17
92.—Pneumonia	446	2	17	213	105	55	19	35
93. (*a*) Empyema	21	—	1	14	2	4	—	—
93. (*b*) Other Pleurisy	15	—	1	6	7	—	—	1
94.—Pulmonary Congestion, Pulmonary Apoplexy	25	1	—	8	8	4	—	4
95.—Gangrene of the Lungs	1	—	—	1	—	—	—	—
96.—Asthma	36	1	2	17	8	6	1	1
97.—Pulmonary Emphysema	—	—	—	—	—	—	—	—
98.—Other Diseases of the Respiratory System (Tuberculosis excepted)	13	1	1	7	3	1	—	—
V.—Diseases of the Digestive System.								
99. (*a*) Diseases of the Teeth and Gums (Oral Sepsis)	—	—	—	—	—	—	—	—
99. (*b*) Thrush, Stomatitis	18	—	—	7	5	5	—	1
99. (*c*) Parotitis (Septic)	—	—	—	—	—	—	—	—
99. (*d*) Other Diseases of the Mouth and Annexa	2	—	—	1	—	—	1	—
100. (*a*) Tonsillitis (other than Diphtheritic)	—	—	—	—	—	—	—	—
100. (*b*) Quinsy	—	—	—	—	—	—	—	—
100. (*c*) Other Diseases of the Pharynx	—	—	—	—	—	—	—	—
101.—Diseases of the Œsophagus	—	—	—	—	—	—	—	—
102.—Gastric Ulcer	4	—	—	—	—	3	1	—
103. (*a*) Gastritis, Gastric Catarrh	18	1	—	10	1	5	1	—
103. (*b*) Other Diseases of the Stomach (Cancer excepted)	4	—	—	4	—	—	—	—
104 & 105. (*a*) Epidemic Diarrhœa	1	—	—	—	—	—	1	—
104 & 105. (*b*) Diarrhœa Infantile, Diarrhœa due to food	44	—	1	24	7	9	2	1
104 & 105. (*c*) Diarrhœa undefined	171	—	8	96	38	23	3	3
104 & 105. (*d*) Enteritis	311	3	13	164	71	35	16	9
104 & 105. (*e*) Gastro-enteritis	56	—	9	22	7	14	3	1
104 & 105. (*f*) Colic	—	—	—	—	—	—	—	—
104 & 105. (*g*) Intestinal Ulceration, Colitis	19	—	3	6	5	5	—	—
104 & 105. (*h*) Duodenal Ulcer	—	—	—	—	—	—	—	—
106.—Anchylostomiasis	213	—	3	147	47	9	—	7
107.—Intestinal Parasites	174	—	4	104	23	34	7	2
108.—Appendicitis and Typhlitis	4	—	—	2	—	2	—	—
109. (*a*) Hernia	11	—	—	4	2	4	—	1
109. (*b*) Intestinal Obstruction	14	—	1	5	5	2	—	1
110. (*a*) Psilosis (Sprue or Ceylon Sore-mouth)	3	—	—	1	—	2	—	—
110. (*b*) Other Diseases of the Intestine	14	—	—	11	1	2	—	—
111.—Acute Yellow Atrophy of the Liver	4	—	—	3	1	—	—	—
112.—Hydatid Tumour of the Liver	—	—	—	—	—	—	—	—
113. (*a*) Cirrhosis of the Liver (Alcoholic)	—	—	—	—	—	—	—	—
113. (*b*) Cirrhosis of the Liver (Toxic)	45	—	3	26	12	1	1	2
114.—Gallstones	—	—	—	—	—	—	—	—
115.—Other Diseases of the Liver	20	—	1	15	4	—	—	—
116.—Diseases of the Spleen	3	—	—	2	1	—	—	—
117.—Peritonitis (cause unknown)	55	1	—	34	11	5	—	4
118.—Other Diseases of the Digestive System (Cancer and Tuberculosis excepted)	4	—	—	2	—	1	—	1
VI.—Non-Venereal Diseases of the Genito-Urinary System and Annexa.								
119.—Acute Nephritis	205	—	7	102	43	39	10	4
120.—Bright's Disease	40	—	1	24	7	6	—	2
121.—Chyluria	—	—	—	—	—	—	—	—
122.—Other Diseases of the Kidneys and Annexa	26	1	4	16	4	—	—	1
123.—Urinary Calculi	—	—	—	—	—	—	—	—
124.—Diseases of the Bladder	10	1	—	6	3	—	—	—
125.—Diseases of the Urethra, Urinary Abscess, &c.	2	—	—	1	1	—	—	—
126.—Diseases of the Prostate	—	—	—	—	—	—	—	—
127.—Dseases of the Male Genital Organs (non-venereal)	6	—	—	3	1	2	—	—
128.—Uterine Hæmorrhage (non-puerperal)	—	—	—	—	—	—	—	—
129.—Uterine Tumour (non-cancerous)	1	—	—	—	—	1	—	—
130.—Other Diseases of the Uterus	5	—	1	3	1	—	—	—
131.—Cysts and other Tumours of the Ovary	1	—	—	—	—	1	—	—
132.—Salpingitis and other Diseases of the Female Genital Organs	5	—	—	4	1	—	—	—
133.—Non-puerperal Diseases of the Breast (Cancer excepted)	—	—	—	—	—	—	—	—

(51) *Causes of Deaths, &c.*—contd.

Causes of Deaths.	Colombo Town.	Nationality. Europeans.	Burghers.	Sinhalese.	Tamils.	Moors.	Malays.	Others.
VII.—The Puerperal State.								
134. (*a*) Abortion, Miscarriage	4	—	—	3	1	—	—	—
134. (*b*) Ante-partum Hæmorrhage	—	—	—	—	—	—	—	—
134. (*c*) Ectopic Gestation	—	—	—	—	—	—	—	—
134. (*d*) Other Accidents of Pregnancy	7	—	—	4	1	1	1	—
135.—Puerperal Hæmorrhage	9	—	1	3	4	1	—	—
136.—Other Accidents of Childbirth	4	—	—	3	—	1	—	—
137.—Puerperal Septicæmia	105	—	3	51	19	20	6	6
138. (*a*) Puerperal Albuminuria, Nephritis, &c.	—	—	—	—	—	—	—	—
138. (*b*) Puerperal Eclampsia	18	—	—	7	2	8	1	—
139. (*a*) Puerperal Phlegmasia, Alba Dolens	—	—	—	—	—	—	—	—
139. (*b*) Puerperal Embolism, Sudden Death, &c.	1	—	—	1	—	—	—	—
140. (*a*) Puerperal Insanity	2	—	—	1	1	—	—	—
140. (*b*) Consequences of Childbirth (not otherwise defined)	33	—	3	13	8	8	1	—
141.—Puerperal Diseases of the Breast	1	—	—	1	—	—	—	—
VIII.—Diseases of the Skin and of the Cellular Tissue.								
142.—Gangrene	26	—	—	17	3	4	1	1
143. (*a*) Carbuncle	8	—	—	5	—	2	—	1
143. (*b*) Furuncle (Boil)	—	—	—	—	—	—	—	—
144. (*a*) Phlegmon	1	—	—	1	—	—	—	—
144. (*b*) Acute Abscess, Abscess unqualified	15	—	—	9	3	3	—	—
145. (*a*) Ulcer, Bedsore	38	—	2	26	7	2	—	1
145. (*b*) Eczema	—	—	—	—	—	—	—	—
145. (*c*) Pemphigus	1	—	—	1	—	—	—	—
145. (*d*) Other Diseases of the Integumentary System (Elephantiasis Arabum excepted)	19	1	—	12	4	1	1	—
IX.—Diseases of the Bones and of the Organs of Locomotion.								
146.—Diseases of the Bones (Tuberculosis and Mastoid Disease excepted)	1	—	1	—	—	—	—	—
147.—Diseases of the Joints (Tuberculosis and Rheumatism excepted)	5	—	1	—	3	—	—	1
148.—Amputations	—	—	—	—	—	—	—	—
149.—Other Diseases of the Organs of Locomotion	—	—	—	—	—	—	—	—
X.—Malformations.								
150. (*a*) Congenital Hydrocephalus	1	—	1	—	—	—	—	—
150. (*b*) Congenital Diseases of the Heart	1	—	—	1	—	—	—	—
150. (*c*) Other Congenital Malformations (Still-births excluded)	7	1	1	3	2	—	—	—
XI.—Diseases of Early Infancy.								
151. (*a*) Premature Birth	88	1	5	51	20	5	4	2
151. (*b*) Debility	479	—	23	226	107	90	22	11
151. (*c*) Want of Breast Milk	24	—	1	13	7	2	—	1
151. (*d*) Atrophy, Icterus, Sclerema Neonatorum	2	—	—	2	—	—	—	—
152. (*a*) Atelectasis	7	—	—	5	1	—	1	—
152. (*b*) Injuries at Birth	2	1	—	1	—	—	—	—
152. (*c*) Other Diseases peculiar to early Infancy	6	1	—	4	—	1	—	—
153.—Lack of care	19	—	2	8	6	1	—	2
XII.—Old Age.								
154.—Senility	455	1	15	234	73	99	19	14
XIII.—Affections produced by External Causes.								
155.—Suicide by Poison	2	—	1	1	—	—	—	—
156.—Suicide by Asphyxia	1	—	—	1	—	—	—	—
157.—Suicide by Hanging or Strangulation	8	—	—	5	2	1	—	—
158.—Suicide by Drowning	—	—	—	—	—	—	—	—
159.—Suicide by Firearms	—	—	—	—	—	—	—	—
160.—Suicide by Cutting or Piercing Instruments	—	—	—	—	—	—	—	—
161.—Suicide by Jumping from high places	—	—	—	—	—	—	—	—
162.—Suicide by Crushing	—	—	—	—	—	—	—	—
163.—Suicide by other means	—	—	—	—	—	—	—	—
164.—Poisoning by Food	—	—	—	—	—	—	—	—
165. (*a*) Snake-bite	1	—	—	—	1	—	—	—
165. (*b*) Insect Stings (Venomous)	—	—	—	—	—	—	—	—
165. (*c*) Other Acute Poisonings	3	—	—	3	—	—	—	—
166.—Conflagration	—	—	—	—	—	—	—	—
167.—Burns (Conflagration excepted)	22	—	1	18	1	1	—	1
168.—Absorption of Delcterious Gases (Conflagration excepted)	2	—	—	—	2	—	—	—
169.—Accidental Drowning	19	2	1	7	6	1	1	1
170.—Traumatism by Firearms	2	1	—	1	—	—	—	—
171.—Traumatism by Cutting or Piercing Instruments	1	—	—	1	—	—	—	—

(51) *Causes of Deaths, &c.*—contd.

Causes of Deaths.	Colombo Town.	Nationality. Europeans.	Burghers.	Sinhalese.	Tamils.	Moors.	Malays.	Others.
172. (*a*) Traumatism by Fall from trees	7	—	—	5	—	—	—	2
172. (*b*) Traumatism by Fall from heights other than trees	—	—	—	—	—	—	—	—
172. (*c*) Traumatism by other Accidental Fall.	6	—	—	3	2	1	—	—
173.—Traumatism in Mines and Quarries	—	—	—	—	—	—	—	—
174.—Traumatism by Machines	—	—	—	—	—	—	—	—
175.—Traumatism by Other Crushing (Vehicles, Railroad, Landslides, &c.)	20	—	—	10	6	2	1	1
176.—Injuries by Animals	2	—	—	1	1	—	—	—
177.—Starvation	4	—	—	1	2	1	—	—
178.—Excessive Cold	—	—	—	—	—	—	—	—
179.—Effects of Heat	—	—	—	—	—	—	—	—
180.—Lightning	—	—	—	—	—	—	—	—
181.—Electricity (Lightning excepted)	—	—	—	—	—	—	—	—
182.—Homicide by Firearms	—	—	—	—	—	—	—	—
183.—Homicide by Cutting or Piercing Instruments	5	—	—	5	—	—	—	—
184.—Homicide by other means	—	—	—	—	—	—	—	—
185.—Fractures (cause not specified)	19	2	—	12	3	2	—	—
186. (*a*) Judicial Hanging or Execution	17	—	—	16	1	—	—	—
186. (*b*) Other External Violence	6	—	—	4	1	—	—	1
XIV.—Ill-defined Diseases.								
187. (*a*) Dropsy	5	—	—	4	—	1	—	—
187. (*b*) Ascites	1	—	—	—	1	—	—	—
187. (*c*) Other Ill-defined Organic Disease	2	—	1	—	—	1	—	—
188. (*a*) Syncope	—	—	—	—	—	—	—	—
188. (*b*) Sudden Death (not otherwise defined).	—	—	—	—	—	—	—	—
189. (*a*) Heart-failure	21	—	1	14	5	1	—	—
189. (*b*) Atrophy, Debility, &c., one year and over	213	—	5	132	37	32	4	3
189. (*c*) Teething	—	—	—	—	—	—	—	—
189. (*d*) Pyrexia	69	—	2	45	13	7	—	2
189. (*e*) Marasmus and Asthenia	214	—	7	117	24	50	16	—
189. (*f*) Other Ill-defined Causes	18	—	1	4	4	5	—	4
189. (*g*) Diseases not specified	2	1	—	—	—	1	—	—

(52) *Changes in the Personnel of the Staff, 1921.*

Clerks.—Mr. H. Weerappa appointed Assistant Registering Clerk on January 15, 1921, in place of Mr. H. G. J. Silva promoted to Works Department.

Mr. J. V. Mendis appointed Accounts Clerk on March 30, 1921.

Mr. P. B. Dabera appointed Clerk on June 1, 1921, in place of Mr. J. V. Mendis, promoted.

Mr. K. L. V. Silva appointed Clerk and Assistant Superintendent, Slaughter-house, on October 1, 1921, in place of Mr. J. de A. Seneviratne, deceased.

Mr. G. B. Silva appointed Record Clerk on October 1, 1921, in place of Mr. K. L. V. Silva, promoted.

Mr. J. A. A. Fernando appointed Clerk, Bacteriological Laboratory, on November 1, 1921, in place of Mr. G. B. Silva, promoted.

Inspectors.—Mr. M. C. Fernando appointed Temporary Plague Inspector on August 12, 1921.

Overseers.—Mr. W. Greg. Fernando appointed Temporary Plague Overseer on August 13, 1921; Mr. B. D. Cornelis appointed Temporary Plague Overseer on August 12, 1921; Mr. P. W. Simons appointed Temporary Plague Overseer on August 13, 1921; Mr. W. H. de Moor appointed Temporary Plague Overseer on August 16, 1921; Mr. T. J. Sally appointed Temporary Plague Overseer on August 17, 1921; Mr. C. H. Grabau appointed Temporary Plague Overseer on September 1, 1921; Mr. J. Martin appointed Temporary Plague Overseer on December 1, 1921, in place of Mr. C. H. Grabau, resigned.

Market-keepers.—Mr. M. P. Gomes appointed Market-keeper, Colpetty and Bambalapitiya Markets, on June 30, 1921, in place of Mr. C. G. Grero, retired.

Midwives.—Mrs. Rosline Perera appointed Midwife, New Bazaar Division, on August 27, 1921, in place of Mrs. Sarah Dias, discontinued.

Telephone Operator.—Mr. F. H. Diaz appointed Telephone Operator on August 12, 1921, in place of B. D. Cornelis appointed Temporary Plague Overseer.

Orderlies.—K. Abraham Pieris appointed Bicycle Orderly on March 7, 1921.

(53) *Death-rates of the Principal Towns in the East, 1916–1921.*

	1916.	1917.	1918.	1919.	1920.	Average, 1916–1920.	1921.
Colombo rate calculated on the estimated population prior to Census	27·7	24·3	28·0	28·8	29·1	27·6	—
Colombo rates subsequent to 1916 revised according to Census, 1921	27·7	26·7	31·2	32·5	33·3	30·3	33·5
Bombay	31·2	34·1	59·6	70·0	46·8	48·3	—*
Madras	34·5	38·4	60·3	52·4	41·3	45·4	—*
Rangoon	33·8	31·1	47·8	47·7	36·8	39·4	—*
Singapore	29·3	35·8	42·1	33·3	35·5	35·2	—*
Penang	30·1	36·2	41·5	37·4	32·8	35·6	—*
Calcutta	23·9	23·0	33·6	40·3	37·4	31·6	—*

* Not yet received.

Annexure B.

REPORT OF THE CITY ANALYST FOR 1921.

The Laboratory, Hyde Park Corner,
Colombo, January 16, 1922.

I HAVE the honour to submit my yearly report for the year ending December 31, 1921. Samples examined were as follows :—

	Number of Samples.
January.	
Milks	43
Town water	14
Sewages	7
Sulphur	2
February.	
Milks	29
Town water	14
Scum	2
March.	
Milks	44
Town water	14
Sewages	8
Cement from sewer joints	3
Bleaching powder	2
Scrapings from cast iron pipes ..	1
Pipes with incrustation	3
April.	
Milks	89
Town water	14
Well water	2
Sullage	1
May.	
Milks	93
Town water	14
Sewages	8
June.	
Milks	88
Town water	14
Water from the Bacteriologist ..	4
Bleaching powder	4
July.	
Milks	75
Town water	14
August.	
Milks	91
Well water	2
Town water	14
September.	
Milks	83
Well water	1
Town water	14
October.	
Milks	83
Well water	1
Town water	14
November.	
Milks	92
Well water	4
Town water	14
Coke	1
December.	
Milks	87
Town water	14
Well water	3
Total ..	1,124

Total number of milks	897
Total number condemned	220
Total number of town waters	172
Total number condemned	—
Total number of well waters	13
Total number condemned	13
Total number of miscellaneous samples	42
Total number condemned	—

A total of 1,124 samples were examined consisting of milks, waters, cement, sulphur, bleaching powder, sewages, incrustations, sewage scum. 897 milks were examined, of which 220 were condemned as adulterated with water = 24·5 per cent., indicating that larger fines are required. 172 town waters were examined, all of which were found of excellent quality. Experiments in connection with pipe incrustation are still proceeding.

Bleaching powder cannot be used in Ceylon, as the bleach rapidly deteriorates, unless it is stabilized with burnt lime to keep it dry.

Thirteen well waters were examined, 13 were condemned as being unfit for human consumption. Twenty-three sewage analyses made indicated that the drainage works are acting satisfactorily. The scum on the surface of the liquid on the septic tanks has proved troublesome.

The sewer fatality was reported on in conjunction with the Medical Officer of Health.

Sulphur samples examined for purity for fumigation purposes.

ALEXANDER BRUCE.
City Analyst.

Annexure C.

REPORT OF THE MUNICIPAL BACTERIOLOGIST FOR 1921.

CONTENTS.

1.—LABORATORY.

The re-conditioning of the laboratory after the years of retrenchment is now practically complete. New equipment, including a series of electrically heated thermostats and sterilizers has been installed, many minor improvements have been effected, and the gas pressure has been raised by fitting special meters.

I have been increasingly handicapped by lack of space this year, owing to the great increase in the routine work and the room taken up by special apparatus in constant use for research. The recently sanctioned further extension of the laboratory buildings should temporarily overcome this difficulty.

2.—STAFF.

An additional attendant was engaged during the year on a temporary basis. It will be necessary to revive the post of Junior Assistant which was retrenched in 1917.

As a result of an accidental infection with septic matter in the laboratory, I was disabled for four months. The result being that the important researches on the transmission of plague by fleas of the Genus *Xenopsylla* had to be postponed from the 1920–1921 plague season to that of 1921–1922. The work on the cause and prevention of the incrustation of the water mains was much delayed.

Mr. C. A. Woutersz carried on successfully in my absence. In recognition of his long experience the Council changed his designation from Senior Laboratory Assistant to Assistant to the Bacteriologist. A new first class clerk has been appointed. I am able to report that he is performing his duties more efficiently than his predecessor.

3.—DIAGNOSTIC SERVICE.

It is very desirable to extend the diagnostic service for practitioners, and to obtain, if possible, more material from the dispensaries and hospitals treating the inhabitants of the City.

It will be necessary, however, to await the completion of the laboratory extension and to train an additional assistant before undertaking more routine examinations. The tabulated statements annexed show that the routine work now done, in a confined space and with the aid of a small staff, is already enormous.

I should like to impress upon medical men practising in the city the need of employing more modern methods for the diagnosis of continued fevers, and particularly to enter a plea for the more extended use of blood cultures, which afford the only certain means of diagnosing fevers of the enteric group. The necessary culture media can be obtained from the laboratory.

Distribution of Clinical Specimens.

	Examined for.	Number received.	Number Positive.
Diagnostic service for Practitioners	Enteric	80	16
	Tuberculosis	35	11
	Dysentery	7	3
	Diphtheria	12	9
	Hookworm	15	9
	Various	26	12
Municipal Enteric Hospital	Enteric	95	42
	Tuberculosis	4	2
	Malaria	4	3
Public Health Department	Enteric carriers	374	5
	Human Plague	71	40
	Hookworm, &c.	58	45
		781	197

Of the 549 enteric specimens, 461 comprised finger bloods for Widals reaction, 128 fœces, and 60 urines. *B. typhosus* was isolated on three occasions from fœces. No Paratyphosus A or B were isolated this year.

4.—PUBLIC HEALTH BACTERIOLOGY.

On March 12, 1921, my assistant brought a shaving brush of Japanese manufacture for examination at the laboratory. It was found to be heavily infected with virulent anthrax.

The whole stock of the firm selling these brushes was given up for examination. Five packets, all Japanese, were found to be infected. Accordingly, the whole consignment of 219 brushes was destroyed. It is extremely difficult effectually to disinfect a brush infected with the highly resistant spores of *B. anthracis*. The bristles comprised in these brushes are in all probability derived from the hides of animals who had died of anthrax on the plains of Siberia or Manchuria, where this disease is rampant.

409 goats out of 503 examined died of anthrax at the slaughter-house during the year.

The threatened invasion of Colombo by malaria raises a number of problems requiring special investigation. I propose to enlist the co-operation of the Government Malariologist for their solution.

It will be necessary to attempt a protozoological survey of the blood of the citizens of Colombo. This could be best done by examining blood films from all those patients complaining of fever who attend the dispensaries and hospitals during the malarial season, encouraging the medical men practising in the city to send in blood films from their fever patients, and examining school children.

(a) General Distribution of Specimens examined during 1921.

	Number received.	Positive.
Clinical specimens	781	197
Town water	148	—
Other waters	33	—
Goats blood for anthrax	503	409
Shaving brushes for anthrax	269	6
Rat fleas for species distribution	1,731	—
Soil for hookworm larvæ	33	—
Miscellaneous	5	—
Rodents for plague :—		
Port Commission	8,907	8
Veterinary Department	19,806	10
Public Health Department :—		
Rats found dead	164	26
Rats killed by Clayton machines	4,213	22
Veterinary Department for flea index	3,323	—
	39,916	

(b) Distribution of Rodents examined for Plague, 1921.

	Species.	Number examined.	Number Infected.	Percentage Infected.
Trapped Rodents	R. rattus	20,813	8	0·04
	R. norvegicus	4,623	5	0·1
	M. musculus	1,860	—	—
	C. cœrulea	105	—	—
	Bandicoots	13	—	—
Rats found dead	R. rattus	114	23	20·17
	R. norvegicus	68	7	10·3
	M. musculus	47	—	—
	C. cœrulea	—	—	—
Rats killed by Clayton machines	R. rattus	1,781	11	0·62
	R. norvegicus	1,655	11	0·67
	M. musculus	1,992	1	0·05
	C. cœrulea	19	—	—
		33,090	66	0·19

The 155 mummified rates received for examination are not included in the above.

(c) Monthly Flea Index, 1921.

Month.	Number of R. rattus examined.	Flea Index.	Number of R. norvegicus examined.	Flea Index.
January	197	·71	28	3·1
February	155	·51	60	3·16
March	167	·67	49	2·18
April	174	·52	41	2·97
May	255	·83	23	3·95
June	218	·75	50	1·86
July	184	·67	71	2·11
August	272	·47	61	1·6
September	205	·57	119	1·12
October	223	·55	75	1·72
November	246	1·02	112	2·31
December	274	1·14	64	2·56

Research Reports.

I.—On the Cause and Prevention of the Loss of Carrying Power of the Colombo Water Mains.

Great progress has been made with this investigation during the year under review. A treatment has been discovered, which under laboratory conditions prevents the growth of iron bacteria in the water supply. An experimental plant has been erected in the vicinity of the Maligakanda reservoir for the treatment of the water by the new process on a large scale.

Most of the laboratory experiments and the most successful part of the large scale experiments were carried out with town water, only part of which had passed through the Jewell filters owing to difficulties of supply during the period when the Maligakanda service reservoir was under repair. This partially unfiltered water was particularly favourable to the growth of iron bacteria, probably owing to the presence of large amounts of iron and organic matter in an unoxidized condition. It also contained a much larger quantity of the iron bacteria themselves.

There was a striking contrast between the behaviour of the experimental pipe kept in the laboratory before and after the periods when unfiltered water passed through it. During the passage of the unfiltered water the incrustation grew at a much more rapid rate. Thus showing that the Jewell mechanical filters have been performing a great service. Their utility depends quite as much if not more on the oxidation of organic matter and the removal of precipitated ferric hydrate as on the straining off of micro-organisms.

The work done in the laboratory during 1920–1921 showed that the filters are effective as strainers of plankton organisms, but are not very efficient bacteriologically.

In this connection it is interesting to note that during 1922 the walls of the settling tank became coated throughout with a thick layer of polyzoa. No polyzoa were found on the walls of the filtered water basin. The polyzoa are very large organisms ; even the statoblasts or winter eggs are easily visible to the naked eye. The growth has a brown mossy appearance. Polyzoa belong to the animal kingdom.

When some further experiments have been carried out at Labugama with unfiltered water, this investigation, which has been carried on at intervals for several years, will be complete, and a problem of pecular difficulty will be solved. It is hoped this year to issue a final report with schedules of the experimental details and of the analyses by the City Analyst. This report will contain more detailed rccommendations for the future treatment of the water supply.

The succeeding paragraphs give a general account of the problem, and indicate the means for its solution.

Cause of the Incrustation of Water Mains.—These may be divided into three classes.

(*a*) *Precipitation of Salts on the Walls of the Pipe by Chemical Action.*—Thus the Roman aqueduct of Pont du Gard in France was found to have a lining one foot thick composed of calcium carbonate deposited from water in the course of centuries.

(*b*) *The Tuberculation and Rusting up of Unprotected Iron Pipes.*—The iron in this form of incrustation is derived from the walls of the pipes, and the process depends on the presence of dissolved oxygen and free carbonic acid in the water, which attack the pipe walls. It is prevented by varnishing the pipes.

(*c*) *The Activities of certain Classes of Micro-organisms present in the Water and growing on the Pipe Walls.*—Valuable reports have been received this year from Dr. David Ellis of the Royal Technical College, Glasgow, and W. J. Hodgetts, M.Sc., of the University of Birmingham, on the iron bacteria and algæ of the Colombo water supply. In 1913 Sir Sidney Harmer, F.R.S., Director of the Natural History Museum, and in 1920 Dr. Annandale, Director of the Indian Zoological Survey, reported on the species of polyzoa found in the Colombo waterworks. Mr. Hodgetts confirmed Dr. Ellis's observation that *Leptothrix ochrea* was the principal iron bacterium in the water supply.

Leptothrix ochrea, according to Ellis, is the most widely distributed iron bacterium found in ferruginous waters throughout the world. Its presence in Ceylon has been previously recorded by Molisch, who first grew it in pure culture.

This organism in nature only appears in water containing iron or manganese in solution.

The iron is replaceable by manganese, and is probably bound up with an easily oxidizable organic molecule.

An important feature of the growth of *Leptothrix ochrea* is its tendency to gelatinize, thus forming a sticky surface to which all kinds of algæ and protozoa adhere, and particularly any ferric hydroxide in the colloid state happening to be present in the water. It is the presence of iron in the substance of the organisms, and entangled to its gelatinous sheath, which strengthens the superficial layers of the crust formed in the pipes, and enables it to resist the scouring action of the current of water passing through them.

The incrustation is doubly formed by the activities of both polyzoa and iron bacteria. Various algæ play a secondary part. The polyzoa are still found occasionally in the water mains, but have played only a minor rôle in the formation of the incrustation since the installation of the mechanical filters.

Polyzoa grow on the walls of pipes as a friable mossy layer. Tufts of moss are frequently detached from the walls of the pipes by the current of water passing through them.

Prior to the installation of the filters such tufts were always to be seen passing over the spill into the Maligakanda reservoir.

Polyzoa are easily flushed off the walls of the pipe. They are harmless in the living state, and may even serve a useful purpose by ingesting more objectionable organisms in the water. After death they readily break down, the products of their decomposition foul the water, and provide a culture medium for micro-organisms, including iron bacteria.

Development of the Incrustation.—Periodic observation of the interior walls of the experimental pipe in the laboratory shows exactly how the crust is formed. Water is passed constantly through this pipe at a slow uniform rate.

It begins as a thin galatinous coating of the whole interior surface of the pipe. It appears first at points where there is some obstruction to the flow of water, such as an angle or bend in the pipe line.

The next stage is the formation of tubercles at various points, very similar in general appearance to those produced by the chemical action of certain waters on unprotected pipes. The microscopic examination of scrapings from the surface of these tubercles shows a network of living iron bacteria, with all kinds of small algæ, crustacea, protozoa, and small oligochætes entangled in the mesh.

Beneath this is the harder reddish crust containing much iron mainly in the form of ferric hydroxide, interlaced with the dead empty sheaths of *Leptothrix ochrea*. These sheaths are thickened with deposited iron ; the empty shells of desmid are also common here.

Next to the pipe wall is a blackish mass consisting of dead organic matter heavily impregnated with magnetic oxide and sulphides of iron. In the midst of this mass are barely recognizable débris of what are probably iron and sulphur bacteria.

In the course of years the tubercles merge together and form a gradually thickening crust lining the pipe, with a very rough irregular surface. This roughness lessens the velocity of flow of water, thereby adding to the effect of the obstruction of the lumen of the pipe. The crust may occupy two-thirds of the diameter of a three-inch pipe. The nett result is to enormously diminish the amount of water delivered to the consumer in a given time.

The matters in suspension, whose appearance is familiar to all consumers of the city supply, mainly consist of fragments detached from the inner gelatinous lining of the pipes. If this suspended matter be kept under observation under the water, it will usually be seen to increase in bulk, as a result partly of multiplication of the iron bacteria, and partly of the gradual deposition of ferric hydroxide from the water upon the sheaths of these organisms. Vigorous flushing and sudden irregularities in the flow of water through the pipes naturally produce a temporary increase of this deposit. This suspended matter is a great nuisance to aerated water manufacturers, and gives consumers an excuse for maintaining unhygienic filters.

The mode of incrustation of water mains by iron bacteria has been investigated by several observers, particularly by Campbell Brown and Jackson.

The former observer states that growth of iron bacteria only takes place in a water containing both iron and organic acid (other than carbonic) in solution, and suggests the addition of lime to such waters.

The writer has found, however, that the addition of lime or soda does not prevent the growth of iron bacteria in the Colombo supply. An alkaline specimen of water treated with lime, in which iron baeteria grew, was sent to Dr. Ellis, who identified these bacteria as *Leptothrix ochrea*. The addition of alkali, therefore, is not sufficient to prevent the growth of these bacteria.

On the other hand, ordinary water bacteria, *B. coli*, &c., are rapidly destroyed by the addition of lime in excess.

Laboratory Experiments on Growth of Iron Bacteria.—The researches carried out in this laboratory indicate that there are three factors principally concerned in the growth of iron bacteria in a water supply. The presence in the water of—

(1) Small quantities of iron in a state of solution or colloidal suspension.
(2) Oxidizable organic matter in small quantity.
(3) Iron bacteria.

There appears to be no doubt the *Leptothrix ochrea* can grow without iron if manganese is present. There is no manganese in the Colombo water. I do not think it is yet established that *Leptothrix ochrea* will grow to any extent in the absence of either iron or its chemical ally, the metal manganese.

Without iron the incrustation would not take a solid form.

Nevertheless, filamentous bacteria do grow in the Colombo water, when only the merest trace of iron is present.

The Problem of preventing the Incrustation.—Dr. Ellis considers the presence of iron is not essential to the growth of Leptothrix, and lays great stress upon the necessity of employing every means to oxidize the available organic matter upon which the organisms feed.

Sir David Prain, the late Director of the Royal Botanic Gardens at Kew, in submitting Mr. Hodgett's report, suggests that defective filtration is responsible for the continuance of the incrustation.

The ideal treatment of the water for the purpose of preventing the bacterial incrustation of the mains would combine, firstly, the removal of the bacteria suspended in the water, and, secondly, the destruction of the bacterial food supply dissolved in the water.

The first object can be achieved by filtration. From a scientific point of view the ideal filtering plant for Labugama would undoubtedly be a series of slow sand filters of the old fashioned type. Practically, the use of such filters is not feasible.

The second object is partly achieved by filtration through sand. The sand granules become coated with a film of organic matter which has the power of oxidizing and absorbing many of the dissolved impurities.

A high efficiency of filtration cannot be obtained with the present system of rapid mechanical filters when worked at the maximum rate of filtration. The filters were designed to work with an artificial coagulant. Owing to the peculiar chemical constitution of the water, its extreme softness, and the paucity of soluble salts, a coagulant can only be used in very small doses.

The filters have been tested by a variety of methods under different working conditions. At maximum rate of filtration, and using natural film, the percentage of organisms removed is approximately as follows :—

	Per Cent.
Ordinary bacteria	50
Iron bacteria, filamentous forms	80
Iron bacteria, sporing forms	50
Polyzoa	99

Using an artificial film produced by the action of suitable doses of lime and alum much better results can be obtained, but the rate of filtration is greatly reduced.

The present installation of filters was designed for filtering a maximum of six million gallons per day.

The actual consumption at present is eight million gallons per day. When the water is unusually turbid, the filters have to be washed unduly often to enable a sufficient quantity of water to pass through them.

Even if the water was suitable for treatment with coagulants, they could not be used unless the number of filters was considerably increased.

The presence of a filtering scum depends on the amount of suspended plankton and precipitated iron, both of which vary enormously.

The frequent absence of a definite surface film has resulted in the sand grains becoming coated with organic matter to an unusual depth, thereby increasing the resistance to filtration of each filtering unit and its biological action on the water. Thus making their action approximate to that of a slow sand filter.

Prevention of Iron Bacterial growth by Disinfecting Mains with Chlorine.—A large number of experiments were carried out in 1920–1921 on the effect of chlorine gas or hypochlorite solutions on iron bacteria.

For ordinary purposes of water purification the chlorine treatment is very extensively adopted in the large cities of England and America.

The continuous addition of chlorine in amounts less than one part per million to waters exposed to sewage contamination results in the destruction of all ordinary disease germs in the water without rendering it unpalatable.

By treatment with an adequate dose of chlorine, followed, if need be, by rapid mechanical filtration, almost any polluted water can be rendered potable at low cost.

It was thought that the Colombo water might be kept free from growth of every description by addition of chlorine. My experiments show, however, that very large doses of chlorine are required to kill such resistant organisms as the iron bacteria, and that large amounts of chlorine are absorbed by the organic matter lining the pipe walls. It may be advantageous to employ a solution containing not less than five parts of chlorine per million to flush out pipes heavily infected with crust-forming organisms.

The difficulty is that no apparatus is at present available for conveniently doing this.

As will be shown later, the chlorine treatment will seldom be needed for the disinfection of the iron bacteria in water mains. It will be much more economical to starve these organisms out by removing their food supply from the water. When dead these organisms break down into a gelatinous substance having the power of taking up iron suspended in the water as ferric hydrate. Thus, the crust formation would not altogether cease, even when the organisms orginally causing it were killed by antiseptics, such as chlorine, or lime in excess.

Prevention of the growth of Iron Bacteria by a Process of Oxidation and Absorption of their Food Supply.—Before discussing this problem it will be well to consider the character of the water in the Labugama lake at different levels.

In the case of most large bodies of water, there is a constant circulation or a seasonal turnover of the whole water from top to bottom, so that there is no constant difference in the chemical and bacteriological quality of the water at different depths. This circulation or turnover is brought about by change of temperature at different seasons or by the action of the wind. In the particular case of Labugama these influences have little effect.

When a diver from the harbour recently descended to the bottom of the reservior he found that the iron rods operating the various valves were free from rust or visible deposit from the 30 feet level downwards. They were as good as new after being submerged for thirty-seven years.

I have drawn samples in vacuum bottles from different levels. Below the 30 feet level the water contains as much as 8 parts of iron per million in the ferrous state. Near the surface the amount of iron is usually small and mainly in the ferric state.

Bacteriologically the deep and surface waters are quite different, as I showed in 1913. After prolonged periods of dry weather and sunshine the surface layers are practically sterile. Rain, however, causes an immediate rise in the bacterial count.

The amount of suspended matter at different depths varies considerably, but is always much greater at the lower levels. If water be brought up in a vacuum bottle from below 30 feet (the oxygen line) and the water be exposed to air, a heavy precipitate appears, consisting of ferric hydrate precipitated from the water as the result of the oxidation of the dissolved ferrous iron present in such large quantities in the bottom water. Only a proportion of this iron can be removed by simple aeration. The residual iron, usually amounting to about 1·5 points per million, is difficult to remove. It can be precipitated by lime in excess, but caustic lime in sufficiently large quantities for this purpose would render the water very objectionable to the consumers.

The liming process was tried on a large scale during 1920, but had to be abandoned for the above-mentioned reasons.

Moreover, *Leptothrix ochrea* still grew in water rendered strongly alkaline by the addition of 4 grains per gallon of lime, nearly all of which was present in the water as caustic alkali.

If the supernatant fluid be drawn off from the aerated deep water after the precipitate has been allowed to settle, it will be found to contain very few organisms. They have been carried down entangled in the precipitate. In spite of the large amount of iron still present in the water, comparatively little growth of iron bacteria will now take place even when *Leptothrix ochrea* is added.

This is in all probability the result of the oxidation of the organic food supply of the micro-organisms.

The action is analogous to that taking place in the Anderson process. In this process the water is brought into contact with bright iron filings in a huge revolving cylinder. The iron is first converted to ferrous hydrate, which takes up an atom of oxygen from the dissolved air in the water and passes it on to the organic matter. The Anderson process is used for the purification of the water supply of Paris and Antwerp and other continental cities.

Iron compounds are not the only ones present in the Colombo supply which promote the growth of objectionable organisms. Sulphur compounds are also present. The odour of sulphuretted hydrogen gas is often perceptible at the straining shaft. The sulphur organism *Beggiotoa alba* has been found on the surface of the filters.

I find that the objectionable constitutents in the water can be absorbed by treatment with coke. The coke needs to be of special quality and preferably to be treated in a special manner. The effect of coke can conveniently be exhibited in the following manner. Let Labugama water be taken from near the surface, mixed with a small quantity of bottom water containing ferrous iron and brought into contact with coke for a short period, usually not exceeding twenty minutes, and then passed through a few inches of sand. Let a control sample of the same water be simply strained in a precisely similar manner, without contact with coke, and let the two samples be compared at intervals.

About half the iron present is usually absorbed by this brief contact with coke. The sulphur gases are also absorbed. The change from dissolved or colloid iron to precipitated iron is promoted. The organic matter appears to be oxidized and absorbed, for little or no growth of iron bacteria takes place in the cokcd waters. The growth in the control water is nearly always abundant and readily visible to the naked eye within a week.

Such water, after being strained rapidly through sand to remove precipitated ferric hydrate, is no longer capable of growing iron bacteria in any appreciable quantity and could be passed through the mains without any fear of a bacterial incrustation developing.

Results equally good cannot be obtained with filtered water delivered at Colombo. The coke treatment must be applied to the raw water.

Subsequent filtration is necessary not only to remove the precipitated ferric hydrate, but also excess of suspended matters.

Efficient filtration by itself greatly diminishes the rate of incrustation in the manner already described.

Treatment of Colombo Water Supply.—What is required for Colombo is a combination of the two methods, *i.e.*, a coke aerating and absorbing plant, followed by as efficient filtration as it is possible to obtain without the use of more than a very small amount of coagulant.

The present number of filters cannot deal with any larger quantity of water than is already passing through them.

One effect of the proposed oxidizing and absorbing plant would be to relieve the filters considerably at certain seasons of the year.

Steps should be taken as soon as possible to provide either a floating arm or a series of additional valve openings, so that the water in the straining shaft may be constantly drawn off at the most suitable level, which is about 2 feet from the surface. This improvement will also relieve the filters. More filtering units will soon be required.

It would probably be an advantage to include layers of the oxidizing minerals, such as oxidium or polarite in the oxidizing and absorbing plant in addition to coke.

There are two main types of apparatus which might be used—

(1) An aerating tower, containing successive trays of coke, &c., through which the water could be passed in thin streams by gravity, passing out from the bottom into the settling basin and thence to the filters.

(2) A tank containing submerged beds or screens of coke, &c. The water would require to be aerated by air under pressure in the neighbourhood of each bed or screen.

Provision would be required in either case for washing each layer, bed, or screen, with a forcible stream of water, at intervals depending on the amount of suspended matter and iron in the water under treatment. Probably once daily would suffice under average conditions at Labugama.

Plant of either type is in operation in various parts of the world for oxidizing impurities in water or for removing excess of iron. Such plants can be constructed very cheaply and operated very economically.

I am convinced that by a combination of the three following means the bacterial incrustation will be almost, if not entirely, prevented, and the water rendered much purer and freer from visible deposit :—

(1) High level draw off for taking water constantly from near the surface.
(2) Treatment with coke in a special apparatus.
(3) Improved filtration.

I have consulted the Waterworks Engineer with reference to the feasibility of these projects from his point of view. He sees no serious engineering difficulty in the way of carrying out any or all of them.

II.—On Plague.

(1) *The Change of Type of the Disease since 1914.*—The dominant type of human plague has been gradually changing since the first outbreak of the disease from the septicæmic to the ordinary bubonic. A similar transformation has taken place in the nature of the epizootic.

The following tabular statements are of interest in this connection :—

Statement showing Type of Rat Plague, 1921.

Species.	Characteristic Post-Mortem appearances.		Suspicious Post-Mortem appearances.		No noteworthy Post-Mortem appearances.	
	Alive	Dead.	Alive.	Dead.	Alive	Dead.
R. rattus	13	12	2	3	4	8
R. norvegicus	6	6	6	1	4	—
M. musculus	—	—	1	—	—	—

The live rats include both those caught in traps and those killed by claytonizing.

The term " characteristic post-mortem appearances " refers to a bubo containing plague bacilli, or a combination of typical plague lesions visible to the naked eye, such as granular liver, pleural effusion, or hæmorrhage into the tissues. " Suspicious post-mortem appearances " include marked subcutaneous congestion combined with enlarged spleen or a pleural effusion without other sign. If plague-like bacilli were found under the microscope in combination with either characteristic or suspicious lesions, the type of rat plague was classed as bubonic.

Statement showing change in Type of Rat Plague.

	Rattus rattus.			*Rattus norvegicus.*		
	1914.	1915.	1921.	1914.	1915.	1921.
Septicæmic type ..	61	20	12	22	9	4
Bubonic type ..	66	13	30	84	21	19
Percentage septicæmic ..	45·08	60·60	28·60	20·75	30·0	17·40

The spleen juice of every rat received at the laboratory is examined microscopically, unless highly decomposed. Positives are confirmed in a large proportion of the cases by isolation of the bacillus in pure culture.

The number of positives would doubtless be further increased if there were a really reliable means of detecting plague in decomposed rat carcases. The Thermo-precipitin test is applicable to decomposed carcases, but is only of real value in confirming septicæmic cases.

Guinea pigs inoculated either cutaneously or subcutaneously with decomposed plague tissue often survive. Four rats found dead with obvious typical plague-like lesions visible to the naked eye were too decomposed for microscopic examination.

Even in bubonic cases the degree of septicæmia and the number of the organisms in the tissues still seem greater in Colombo than elsewhere. The microscopic appearances of the purely septicæmic specimens are as characteristic as ever. Nevertheless, on the whole, the change to the bubonic type will

tend to diminish the value of the microscopic test, while increasing the relative importance of careful inspection of the post-mortem appearances of the diseased rat. The change from the septicæmic to the bubonic type seems to be associated with a lowered virulence of the infecting organisms and a lessened susceptibility of the Colombo rats to plague infection. This is borne out by the results of my experiments on the transmission of plague by fleas. The inoculated rats at death are much less septicæmic than formerly, and they take on the average a longer time to die. Those which died on or after the third day always show visible plague lesions.

(*Read before the Ceylon Branch of the British Medical Association, March, 1922.*)

(2) *Summary of Researches on the Transmission of Plague by Fleas of the Genus Xenopsylla.*—Plague first appeared in India in 1896 at Bombay, spread steadily southward over the Peninsula, and finally broke out in epidemic form at Negapatam at the end of November, 1913.

From the beginning large tracts of country and important cities in India have remained comparatively immune from plague. Islands, as it were, left high and dry in the midst of the epidemic flood. The cities of Madras and Colombo are in constant communication with all parts of plague-infected India. Yet Madras has only suffered from one small outbreak on the outskirts of the city (1905), which was speedily suppressed. The climatic conditions prevailing in both cities at certain seasons of the year are not unfavourable to plague.

Human plague in Colombo was detected by Philip and Castellani on January 24, 1914. Rat plague in Colombo was first detected on February 9, 1914, by Hirst immediately after his return from India. Castellani found no plague among rats caught in the epidemic area till February 10. There was, therefore, a gap of sixteen days between the detection of the epidemic and the epizootic. Both human and rat plague first appeared in Sea street near the harbour. The disease has now become endemic in this quart r of the town. It has been speedily stamped out elsewhere whenever it appeared.

The Plague Commissioners, in spite of extended investigations, were unable to explain the relative immunity of Madras City from plague. They identified the rat flea of the city as *Xenopsylla cheopis*. Hirst (November 15, 1913) addressing a meeting of this Branch of the Association stated that the rat flea of both Colombo and Madras City was *Xenopsylla astia* exclusively. He produced evidence to show that this flea bites man with reluctance at ordinary Colombo temperature. Subsequently (1917) he reported great difficulty in transmitting plague from rat to rat by means of this new species of flea, first described by Rothschild in 1911.

Hirst found *Xenopsylla cheopis* for the first time in Colombo shortly after the outbreak of plague, on rats caught in the vicinity of Sea street. This identification was confirmed by Rothschild in April, 1914. *Xenopsylla cheopis* has been proved by numerous experimenters to be a plague flea and readily bites man. In 1913 Hirst suggested that the relative immunity of Ceylon and parts of Southern India from plague was to be correlated with the geographical distribution of *Xenopsylla astia*. Rothschild (1914) pointed out that the fleas of the Genus Xenopsylla occurring on rats in India were divisible into three species :—*X. cheopis*, *X. astia*, and *X. brasiliensis*. *X. brasiliensis* has not yet been found in Ceylon.

Hirst's hypothesis was investigated in India by F.W.Cragg, 1920–1921, who obtained fleas from all parts of India through the agency of the Sanitary Commissioner. Cragg reports as follows (April 20, 1921): "The liability to severe epidemics of plague in those regions in which *cheopis* is the predominent flea and the absence of such epidemics in regions where *astia* is predominent seem fairly clear." The new hypothesis, therefore, has received strong confirmation. Cragg points out that there is no distinct correlation between difference of climate and the distribution of these fleas.

The distribution of *X. cheopis* and *X. astia* on rats in their relation to plague within the city of Colombo has been specially investigated during 1921–1922. The results are most interesting and may be summarized as follows :—

Hot Weather collection, April 1 to July 31, 1921, from all Parts of the Town.

X. cheopis	.. Nil	*X. astia*	.. 551

Cool Weather collection, October 31 to February 14, 1921–1922.

	X. astia.	*X. cheopis.*	*Cheopis.* Per Cent.
Plague area	791	167	17·43
Non-plague area	824	8	0·96
Sea street (January) *	169	51	23·18
Plague house in Seabeach lane (Decemner 14) * ..	48	41	46·0

* In centre of endemic zone.

Plague area = the endemic zone ; non-plague area = rest of Colombo where only sporadic cases occur.

In view of the fact that there is an old under-ground system of untrapped drains in the plague area which harbour *Rattus norvegicus*, one might expect to find *X. cheopis* more numerous upon this species of rat. This is not the case however.

The full details of these observations will be published later. They lend epidemiological support to the view that *X. astia* is not an efficient porter of plague from rat to rat. A small additional collection of fleas from the plague and non-plague zones is being mounted and will be sent to Rothschild for independent examination.

No attempt will be made here to explain this remarkable difference in the distribution of two species of fleas on the same species of rats within the narrow limits of the Municipality of Colombo.

My earlier experiments on the efficiency of *X. astia* as a porter of plague were handicapped by the lack of a supply of individually identified fleas. A few *X. cheopis* might possibly have been mixed with the fleas presumed to be *X. astia*. This, however, in no way detracts from the value of the negative results obtained.

The identification difficulty has been overcome by the use of two distinct methods. Female fleas were allowed to lay their eggs in test tubes. In a few days the mother flea dies of starvation. It can then be removed and identified under the microscope. Fleas are bred out from the eggs in the manner

formerly demonstrated before this Branch of the Association. Each flea can then be placed in a separate tube with a species label. The alternative method is to lightly chloroform the female flea and lay it on its left side on the stage of the microscope, powerfully illuminated from above. The flea can then be distinguished at a glance by the shape of the *receptaculum seminalis*.

Having obtained a collection of both *X. astia* and *X. cheopis* accurately named by these methods, I have compared the two fleas under similar conditions in two sets of experiments.

(1) Designed to test the readiness with which they bite man ; using the same technique as Martin and Chick (1911). The results confirm my earlier conclusions that *X. astia* does not bite man readily.

(2) Designed to test the readiness with which they transmit plague between rat and rat, and between mouse and mouse. All attempts to carry plague between rats, mice, or guinea pigs, by means of accurately identified *X. astia* have failed. Seventy-five *X. astia* were used in these experiments.

In a similar series of experiments, with only twenty-three *X. cheopis*, plague was carried from mouse to mouse four times during January and February, 1922. The experimental methods were similar to those described in the Plague Commissions reports (1906) and by Martin and Bacot (1914). I shall be pleased to demonstrate them to the members of this Association at my laboratory on a date to be arranged. I hope shortly to report the details of these experiments in full.

Incidentally, a novel method of transmission of plague by fleas has been experimentally tested and given positive results. Martin and Bacot have shown that mice can be infected by the single bite of a plague-carrying flea, whose gizzard is blocked by growth of plague bacilli. They explain the mode of infection by regurgitation of the blood of the host back into its tissues after contact with the plague growth in the gizzard valve of the flea. I suggest that the most frequent mode of transmission of plague by fleas in nature is the carriage of virulent bacilli in the pharyngeal pump of a blocked flea from a rat newly dead of septicæmic plague to a new host, into whose tissues this virulent blood is regurgitated in the manner aforesaid. Martin and Bacot have produced evidence to show that plague bacilli after growing in the stomach of a flea become less virulent than fresh strains.

If the distribution of plague is correlated with the distribution of particular fleas, then it is possible to divide Ceylon and India and their great cities into potential and non-potential plague zones by simply surveying their rat fleas, just as the tropics can be divided into malarial and sleeping sickness belts on the basis of the distribution of particular winged insects. The energies of the Sanitary Departments concerned can then be concentrated on the danger spots, and made increasingly effective in the war against this terrible disease.

The advances recently made in our knowledge of the epidemiology of plague are the direct result of the labours of two workers, namely, the Hon. N. C. Rothschild and Dr. Karl Jordan, who for many years have devoted themselves in a purely scientific spirit to the study of zoology.

Transmission of Plague from Man to Rat and Man to Man by means of X. cheopis.—The number of bacilli usually present in the blood of an ordinary human case of bubonic plague are insufficient to infect a flea of any species. It follows theoretically that there is little danger of this type of plague being spread by fleas from man to man.

Practical experience bears this out abundantly. It has become a common saying in India that the safest place during a plague epidemic is the plague hospital.

The case is quite otherwise with septecæmic human plague. Here, there are amply sufficient bacilli in the blood stream for the infection of a plague-carrying flea, while the extent of surface exposed to the bites of these parasites is enormously greater.

It follows from the above that septicæmic human plague should be carefully isolated in quarters free from any blood sucking insect likely to convey the disease either to rats or human beings.

There is reason to believe that septicæmic human cases have actually given rise to outbreaks of both rat and human plague in Ceylon.

Transmission of Plague from Man to Man by means of Pulex hominis.—*Pulex hominis* is a proved carrier of plague. The writer agrees with Bacot that the importance of this flea in this connection has been under-estimated.

(3) *Improved Methods of Rat destruction.*—Some comparisons were made between the 3 grains Barium carbonate rice flour bait, and a much advertised proprietary rat poison.

The results served to confirm the superiority of the Barium carbonate bait over all others hitherto devised.

The results obtained in this laboratory agree in the main with the findings of Kunhardt and other observers in India as to the great advantage of Barium carbonate as a rat poison.

Indian workers are now taking up the question of rat destruction with renewed vigour as a result of increased confidence in the efficiency of this poison.

Further experiments are being undertaken in the laboratory with a view to overcoming certain local disadvantages of the bait, and determining the most economical and efficient dose of Barium carbonate for use in Colombo.

III.—On Anchylostome Larvæ in Soil.

In May, 1919, eleven coolies working on a trenching ground at the Madampitiya sewage depôt developed "ground itch." They were found to be heavily infected with anchylostomiasis. The dermatitis found on their hands and feet was the typical dermatitis which is produced by anchylostoma larvæ burrowing through the skin. It is through the skin or mucus membrane that the larvæ of the two species of hookworms infecting man penetrate into the body, attaining their full development in the small intestine, which is reached by a circuitous route *viâ* the veins, right heart, lungs, trachea, and œsophagus. Each mature female worm lays an enormous number of eggs which are constantly passed in the fœces and develope into larvæ outside the human body under suitable conditions.

The particular interest of this outbreak lay in the fact that this trenching ground had not been disturbed for three years. Dr. Lucius Nicholls found numerous larvæ in this soil closely resembling those of hookworm. The suggestion is that hookworm larvæ may remain dormant and infective in soil for several years at least. Many observers have brought forward evidence to the same effect.

Till recently our knowledge of the behaviour of hookworm larvæ in soil has been very deficient. The recent researches of Dr. G. Baermann in the Dutch East Indies have drawn general attention to this question, which is now being energetically investigated by the Rockfeller Anchylostomiasis Commission. Recently W. W. Cort and G. C. Payn reported that under tropical conditions hookworm larvæ die out rapidly in soil. At the end of six weeks very few survive.

Treatment campaigns and ordinary sanitary measures have given somewhat disappointing results both in Dutch East India and elsewhere. It was found by Baermann that coolies who had been successfully treated by courses of Ol. Chenopodium and Thymol frequently relapse and became just as severely infected as before in a few months. . It was clear, therefore, that some important factor in the campaign against anchylostomiasis had been overlooked.

Baermann's researches demonstrate that this factor is the presence of numerous hookworm larvæ in the soil in the neighbourhood of human dwellings, and that they are especially abundant in moist patches of soil such as are found in and about cooly lines, where cooking utensils are washed and water drawn.

The hookworm eggs are usually brought on the feet of the coolies from the latrines or defœcation places to the houses where they live.

The larvæ develope, penetrate into the soil just beneath the surface, pass through the first stage of the larval existence, develope a sheath, and are then ready to penetrate the feet and hands of the coolies who come to the " water spots. " Since the same coolies are in the habit of returning to the same spots for washing purposes, a heavy infection is bound to be produced in course of time.

Baermann suggests that by improving latrines and disinfecting water spots this link in the chain of infection can be broken ; a treatment campaign would then produce permanent results.

It is clearly of immense importance to confirm Baermann's work, to clear up certain gaps in our knowledge of the history of hookworm larvæ in soil, and to detect and disinfect as many infected " water spots " as possible.

Observations were made during the year at Madampitiya sewage works and Narahenpitiya night soil depôts, and will be continued.

I have drawn up a scheme for further research into this question, which has been submitted to the authorities of the Rockfeller Foundation at New York.

I am much indebted to Dr. Jacocks, the Director of the Anchylostomiasis Campaign in Ceylon, for supplying copious literature on the subject, and for the loan of the illustrations of hookworm larvæ given in Loos's classical monograph.

My assistant, Mr. C. A. Woutersz, has made excellent copies of these.

There were two main difficulties in the way of research into hookworm larvæ in soil. One is the difficulty of distinguishing these larvæ from other free living nematode larvæ, which are frequently present in uninfected soils. The other was to find a convenient means of isolating the true larvæ from the soil.

The first difficulty has been partially overcome by the researches of Loos, Baermann, and Cort, who have indicated the distinguishing features of hookworm larvæ.

The second was completely overcome by Baermann, who devised a quite simple method, which I have tested in the Municipal laboratary and found to be perfectly efficient.

Further research is urgently required into the problem of the best method of disinfecting the infected " water spots " and soil of every description infected with hookworm larvæ.

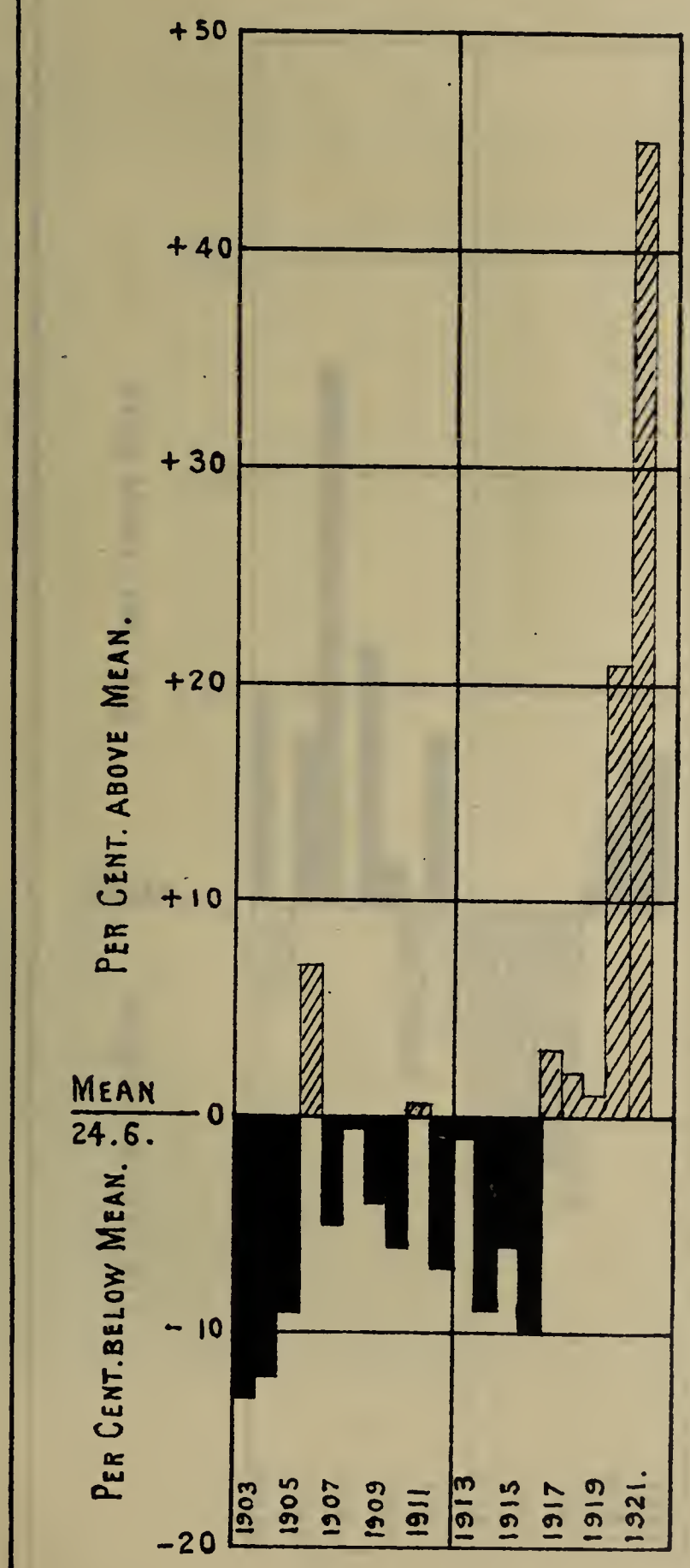
The latter question is of particular importance to Colombo in connection with the future of the site of the Narahenpitiya trenching ground, which will be available for other purposes when the Mansergh drainage system is in full operation.

March 30, 1922.

L. F. HIRST,
Municipal Bacteriologist.

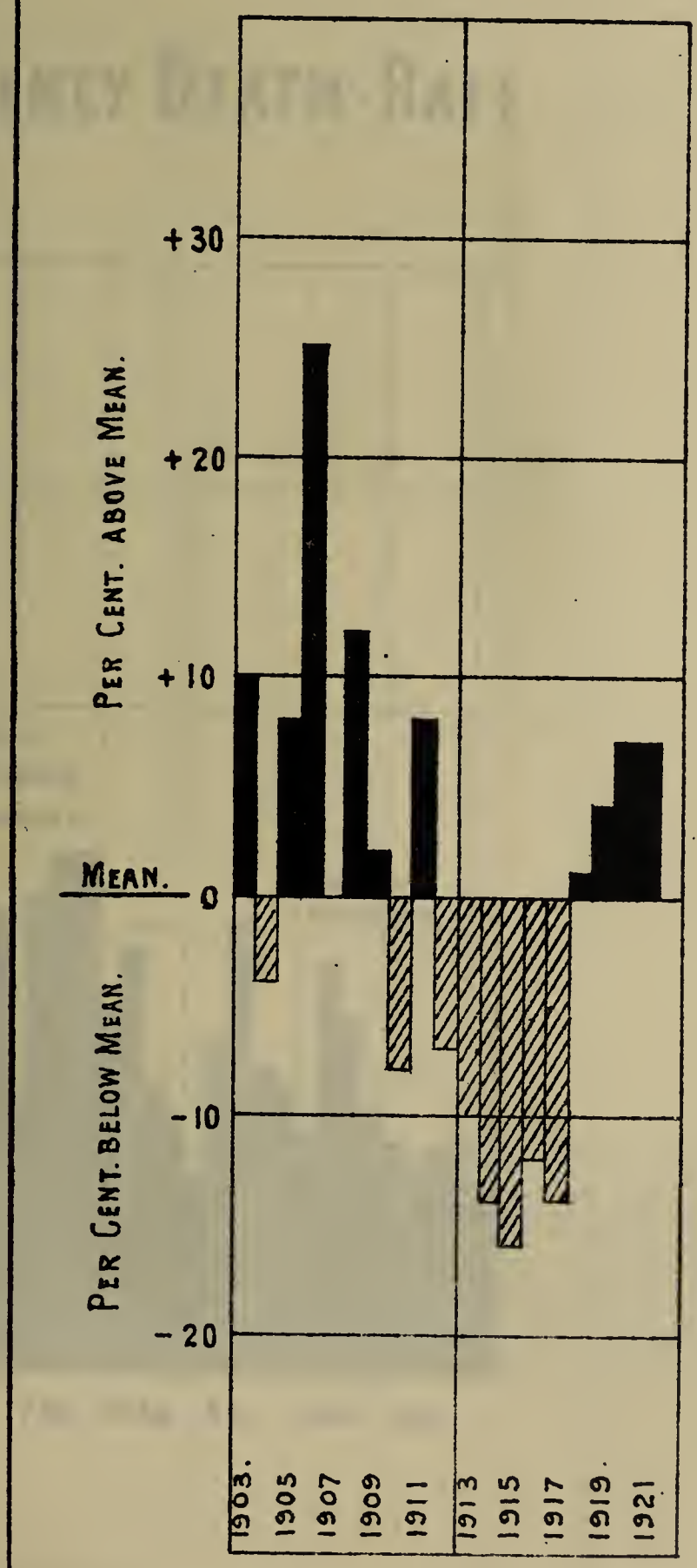
H. R. COTTLE, GOVERNMENT PRINTER, COLOMBO, CEYLON.

BIRTH RATE 1903-1921

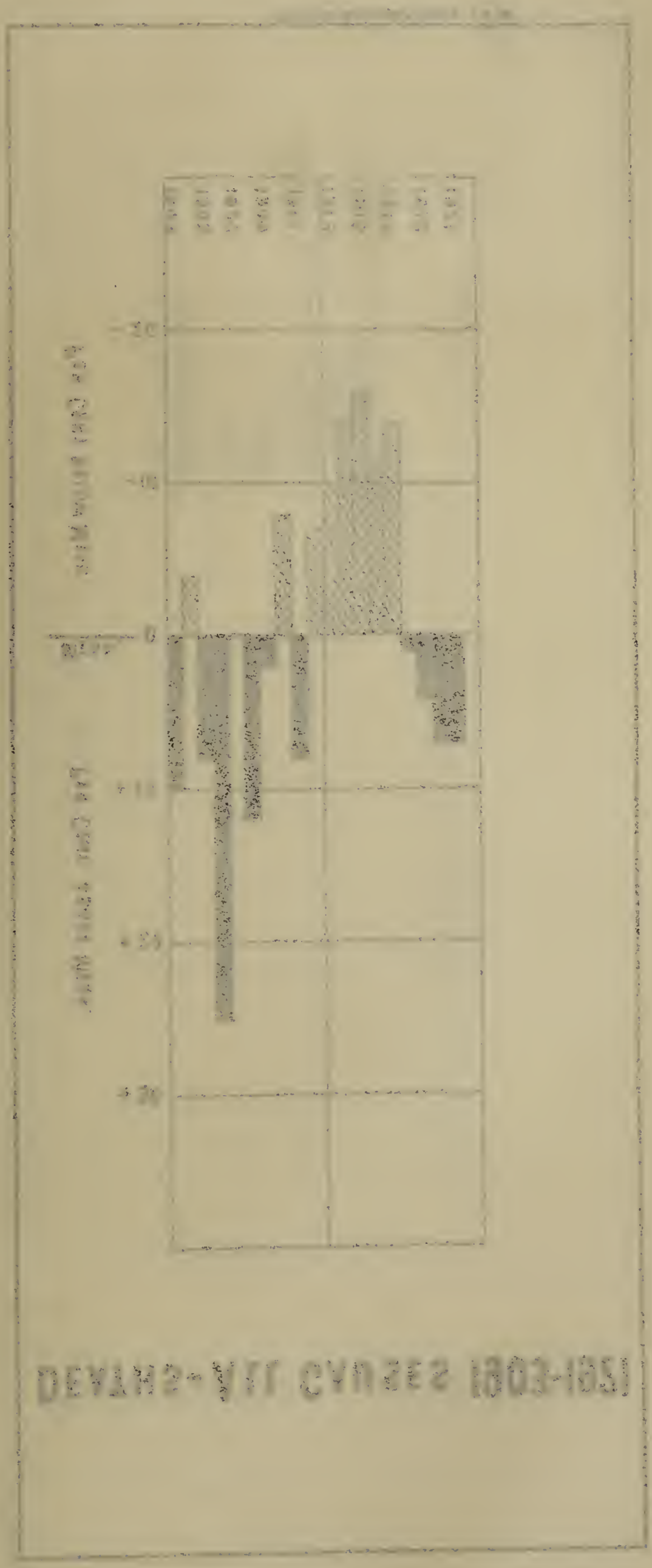


Photo, Litho, Survey Dept. Ceylon. 4. 8. 22

DEATHS-ALL CAUSES 1903-1921



Photo, Litho, Survey Dept. Ceylon 11.8.22



WEEKLY DEATH-RATE. ALL CAUSES. 1921.

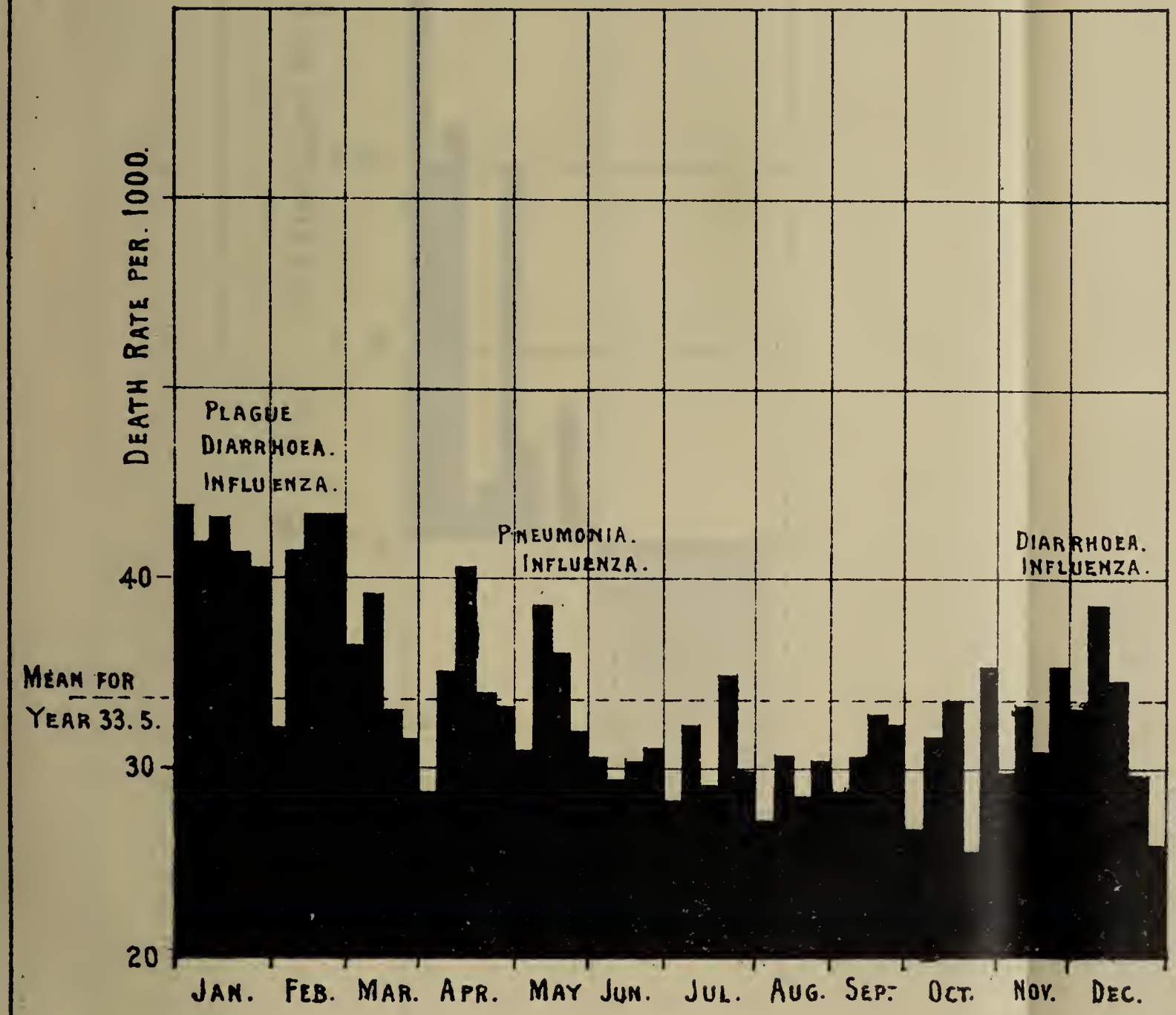


Photo Litho Survey Dept Ceylon 11 8 22

INFANT MORTALITY 1903-1921

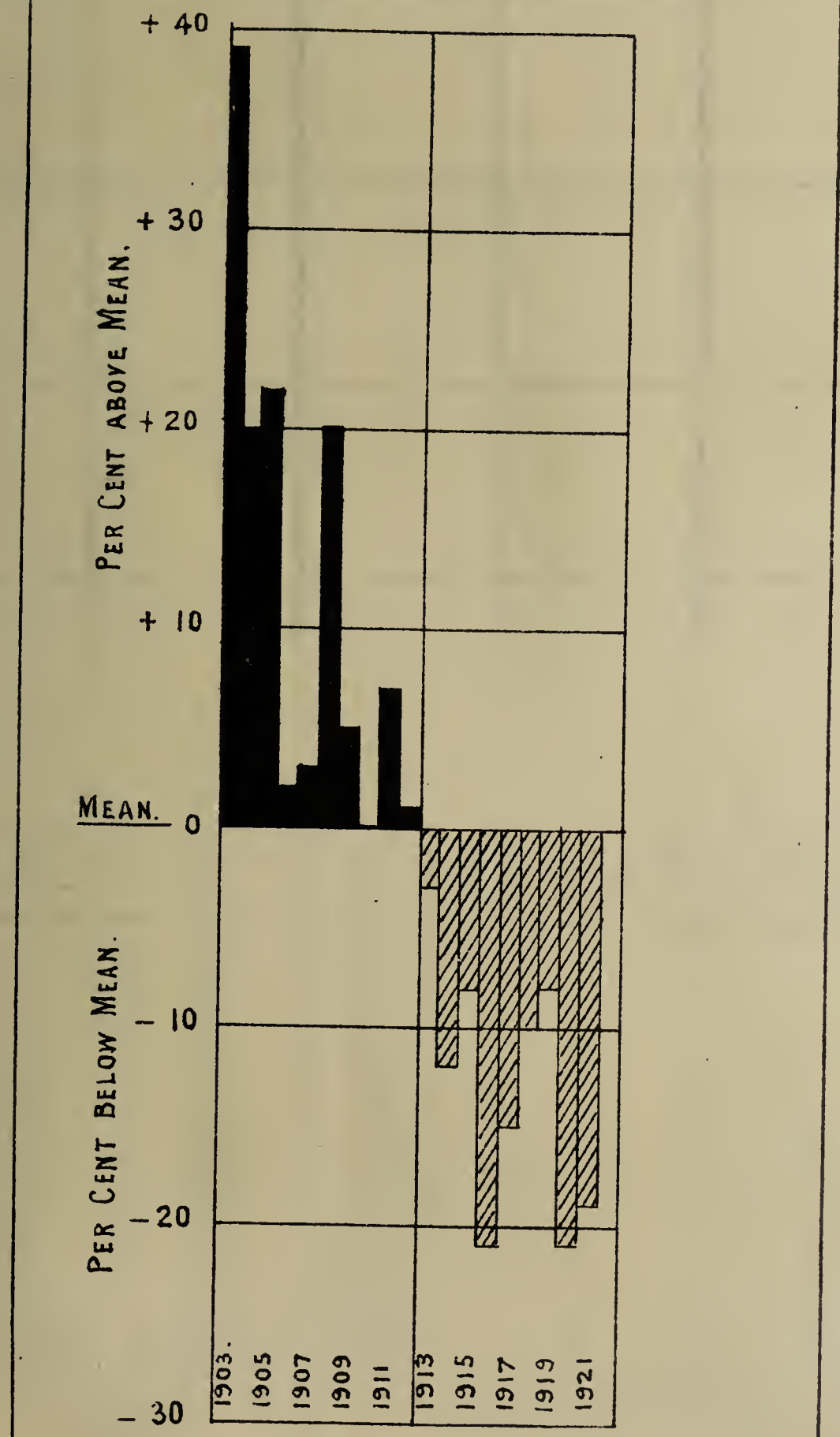


Photo-litho, Survey Dept: Ceylon. 11. 8. 22


INFANT MORTALITY 1903-1951

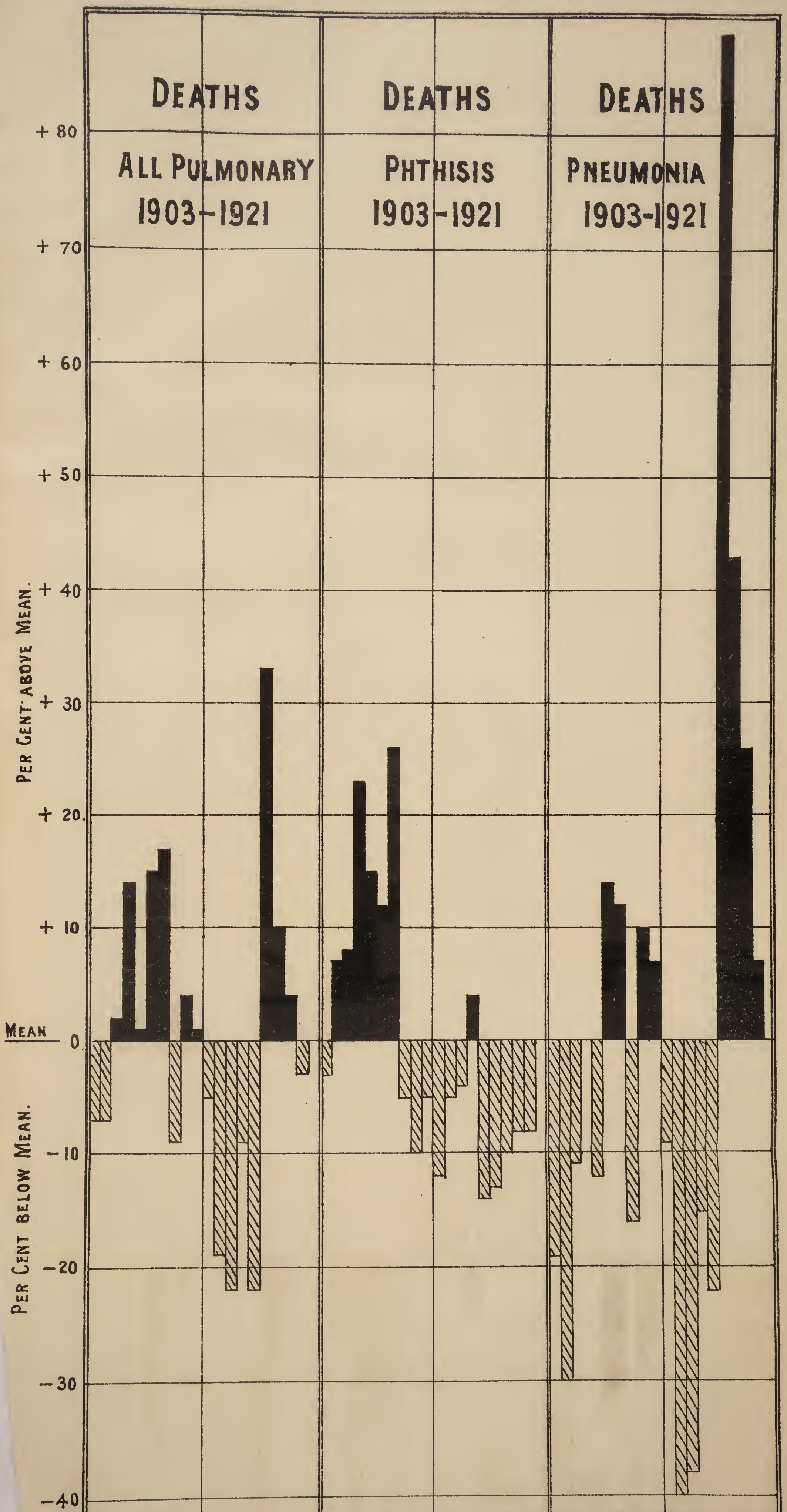


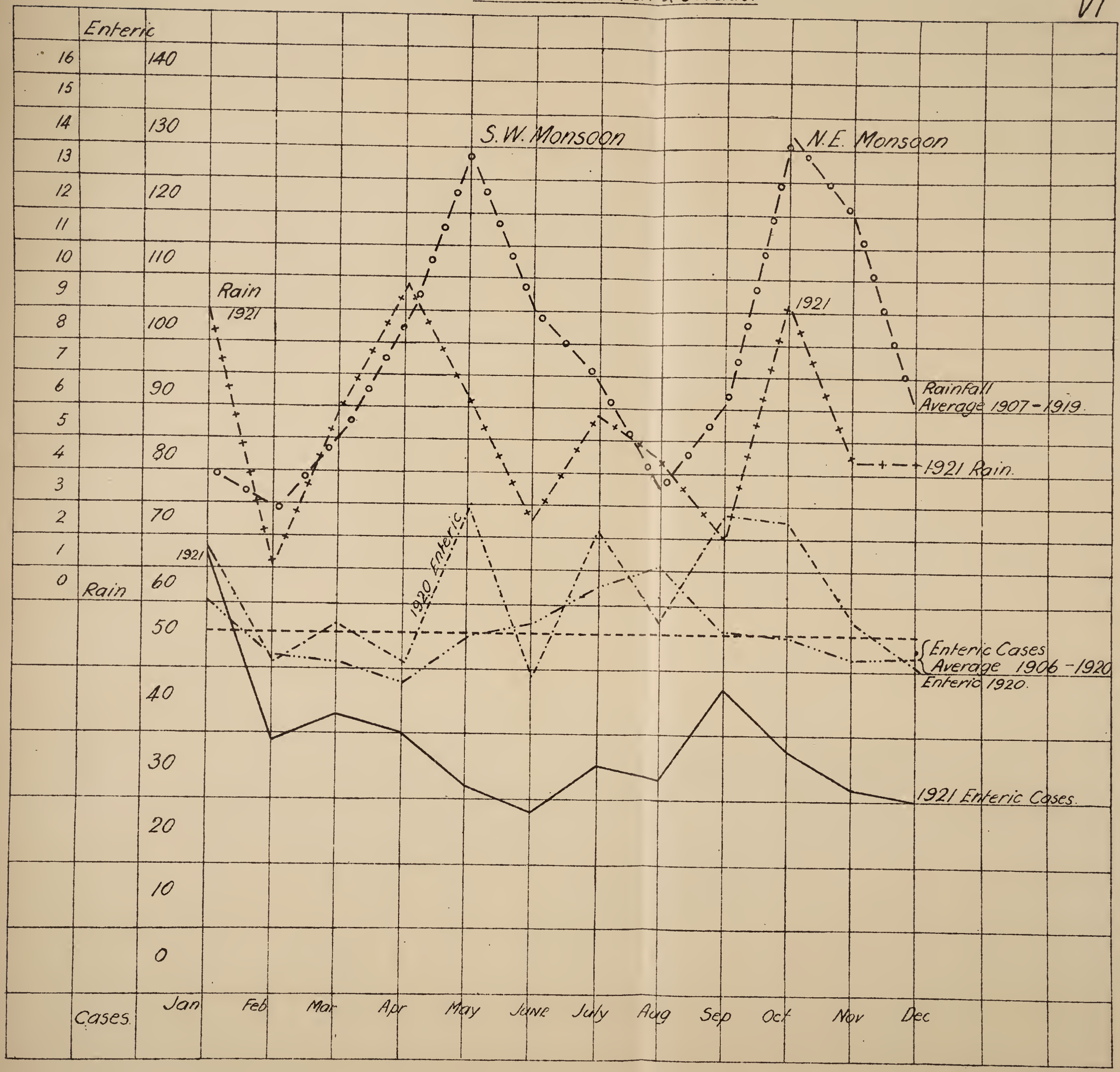
PHOTO LITHO SURVEY DEPT. CEYLON 10.8.22

DEATHS
DEATHS
DEATHS

ENTERIC FEVER CASES

Exclusive of Port & Outside.

VI



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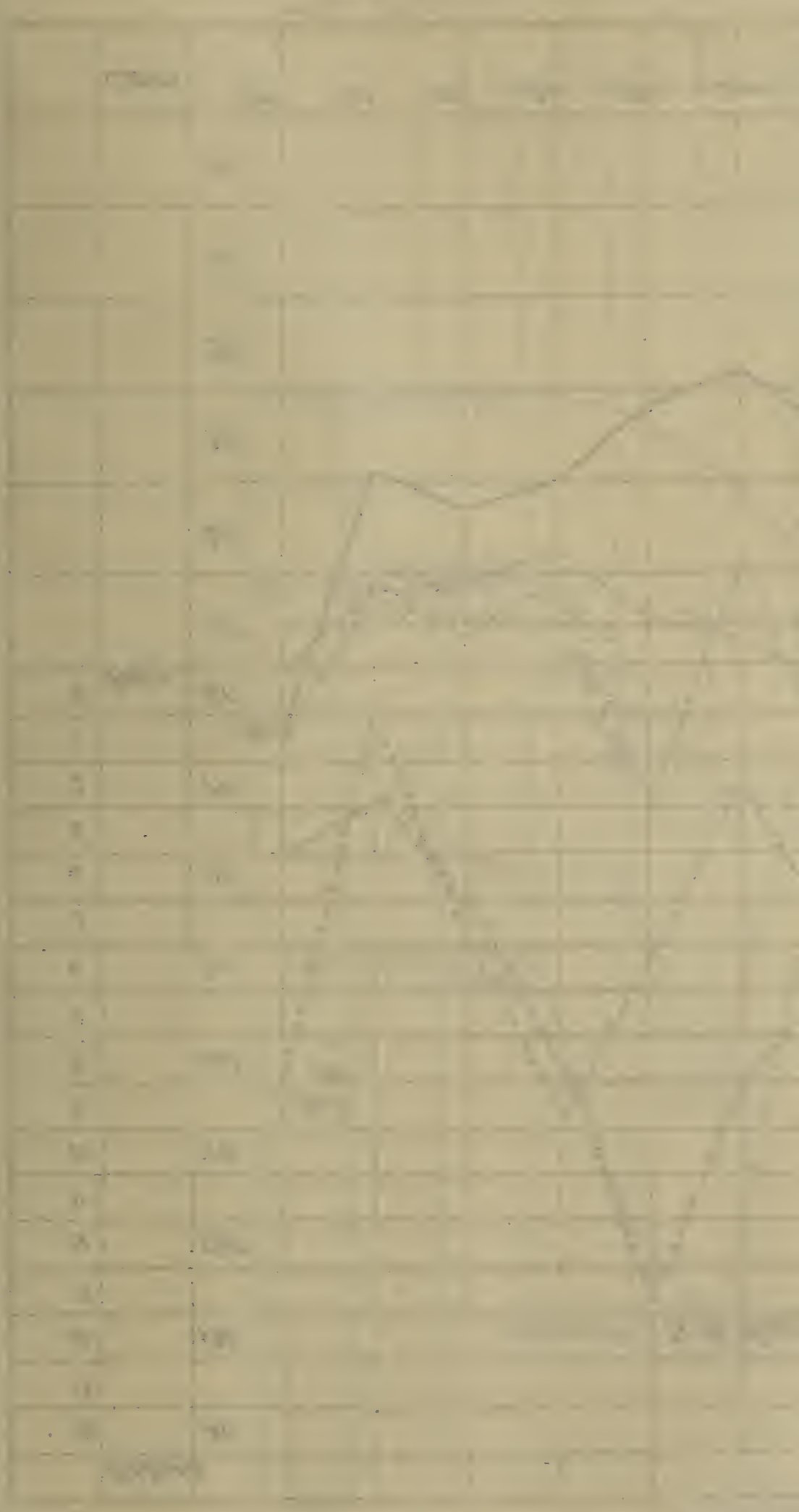
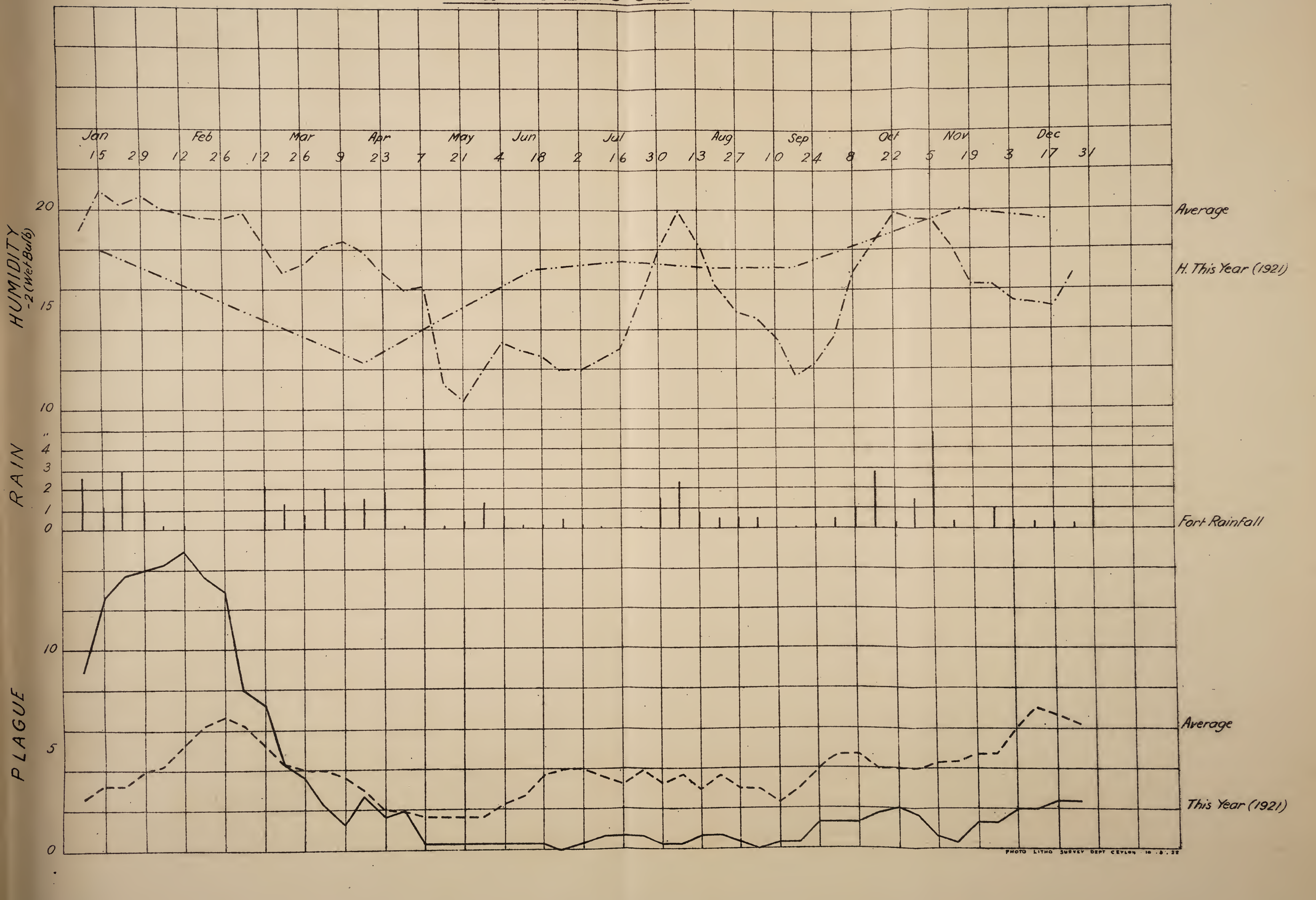
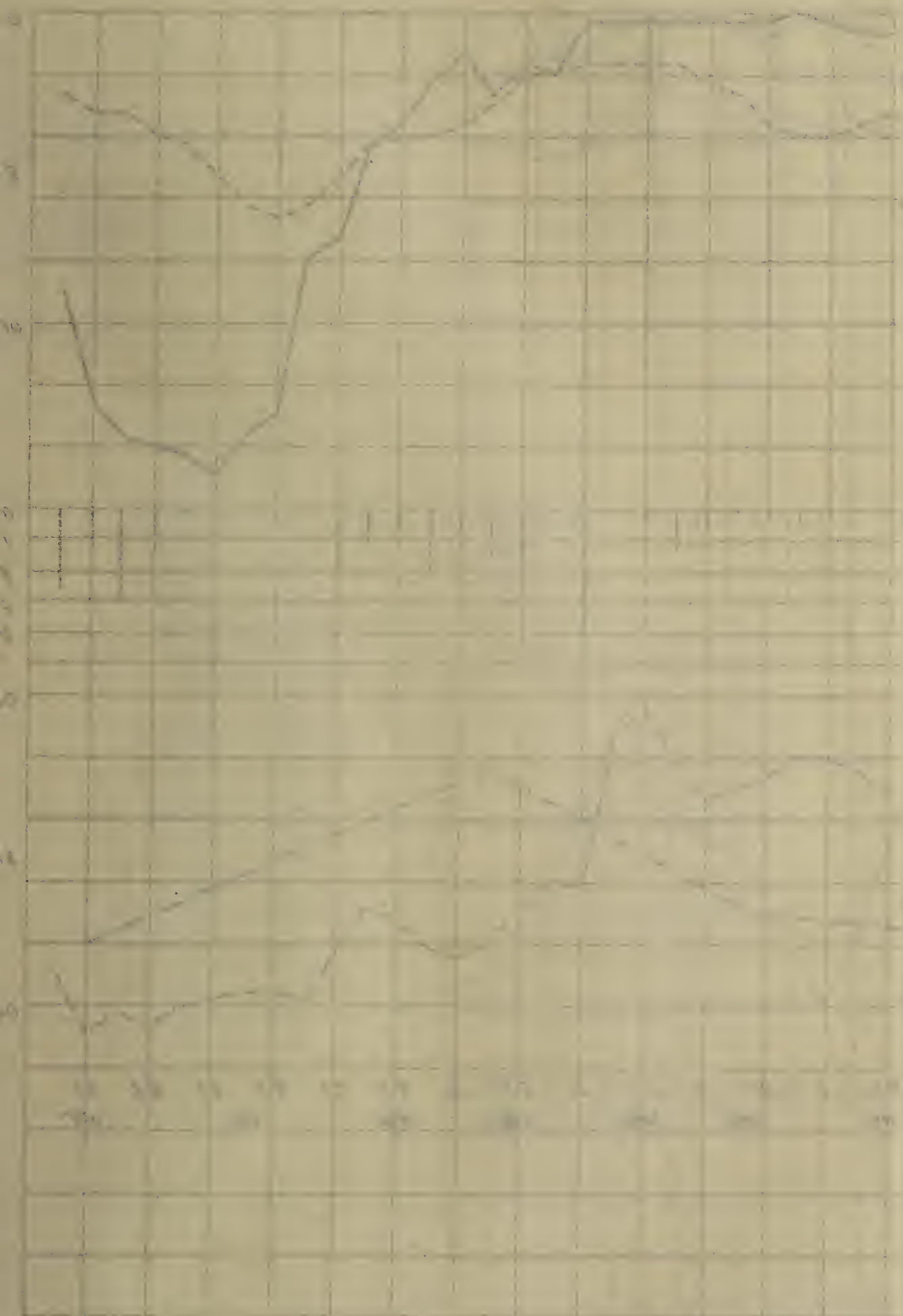


VII

1921 PLAGUE





PLAGUE CASES 1921. BY DATE OF ONSET.

SHADED= 1921.
PLAIN = AVERAGE 1914-1921.

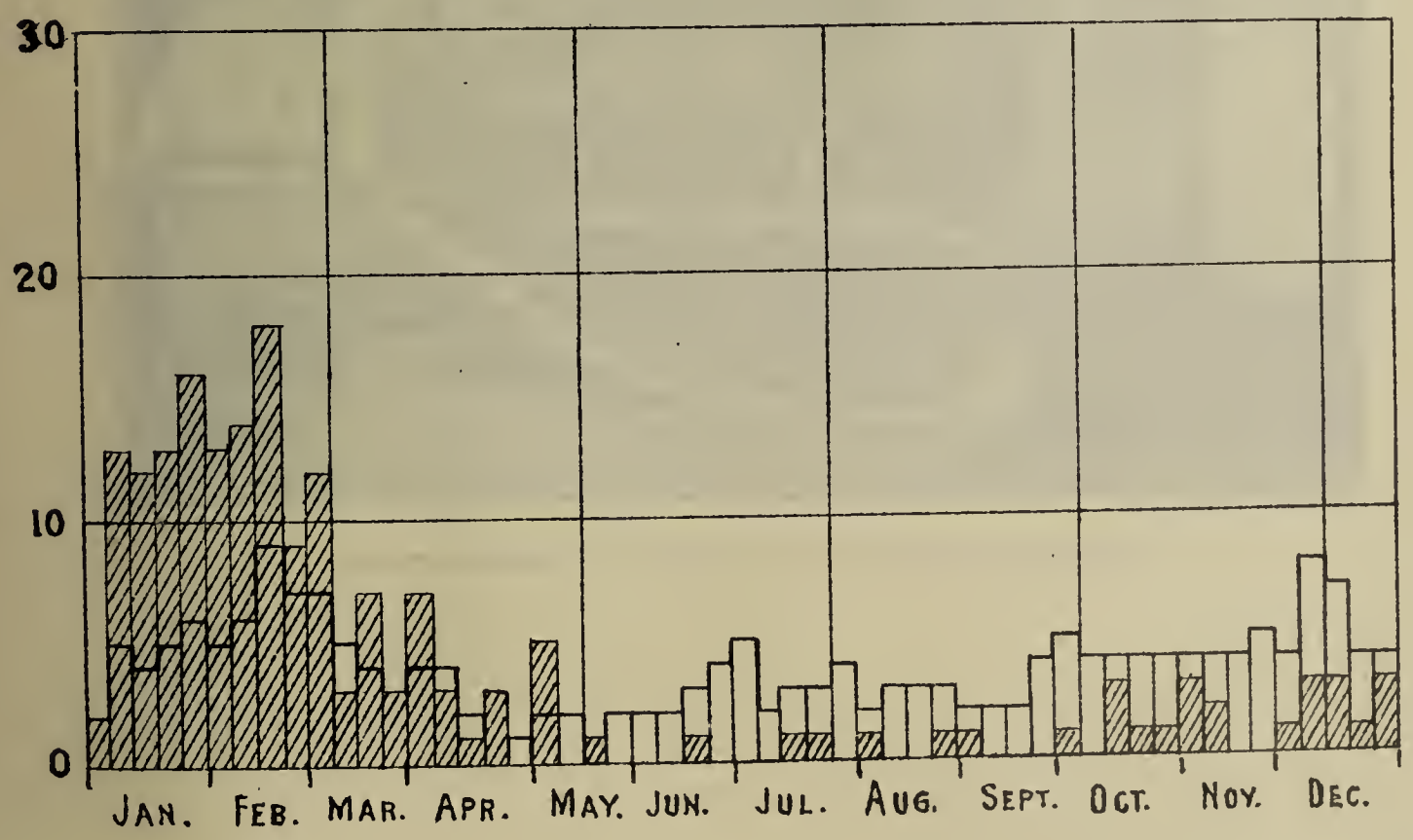


Photo Litho Survey Dept Ceylon
11 - 8 - 22.

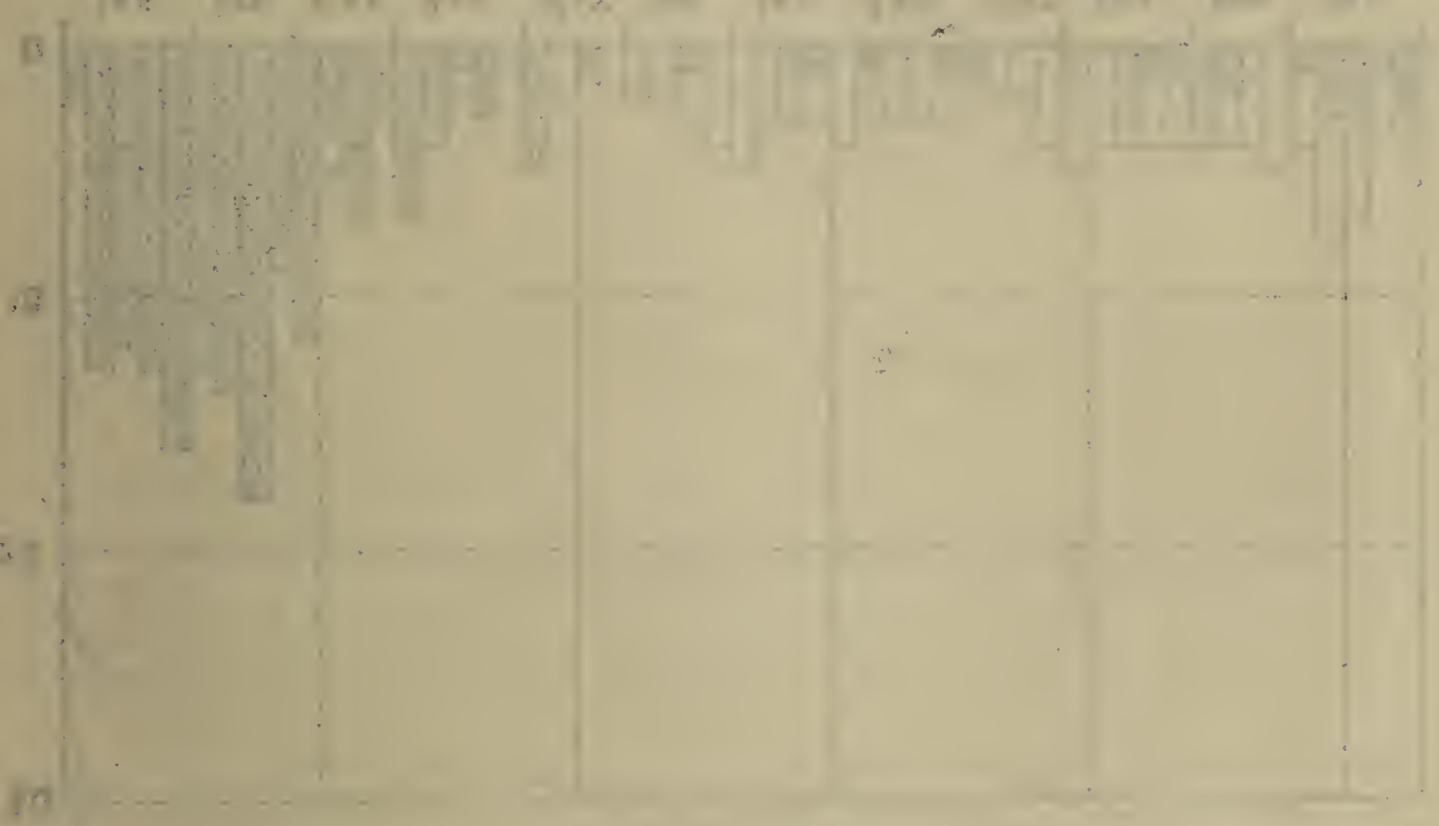


Photo I.

THE FUMIGATION (AT MARADANA BAZAAR) 14(1) DEAN'S ROAD.

Photo II.

TOTAL, 32 RATS. THE BAG, 9–12–21.

Photo III.

TURNING OUT AND FUMIGATING JAMPETTAH STREET.

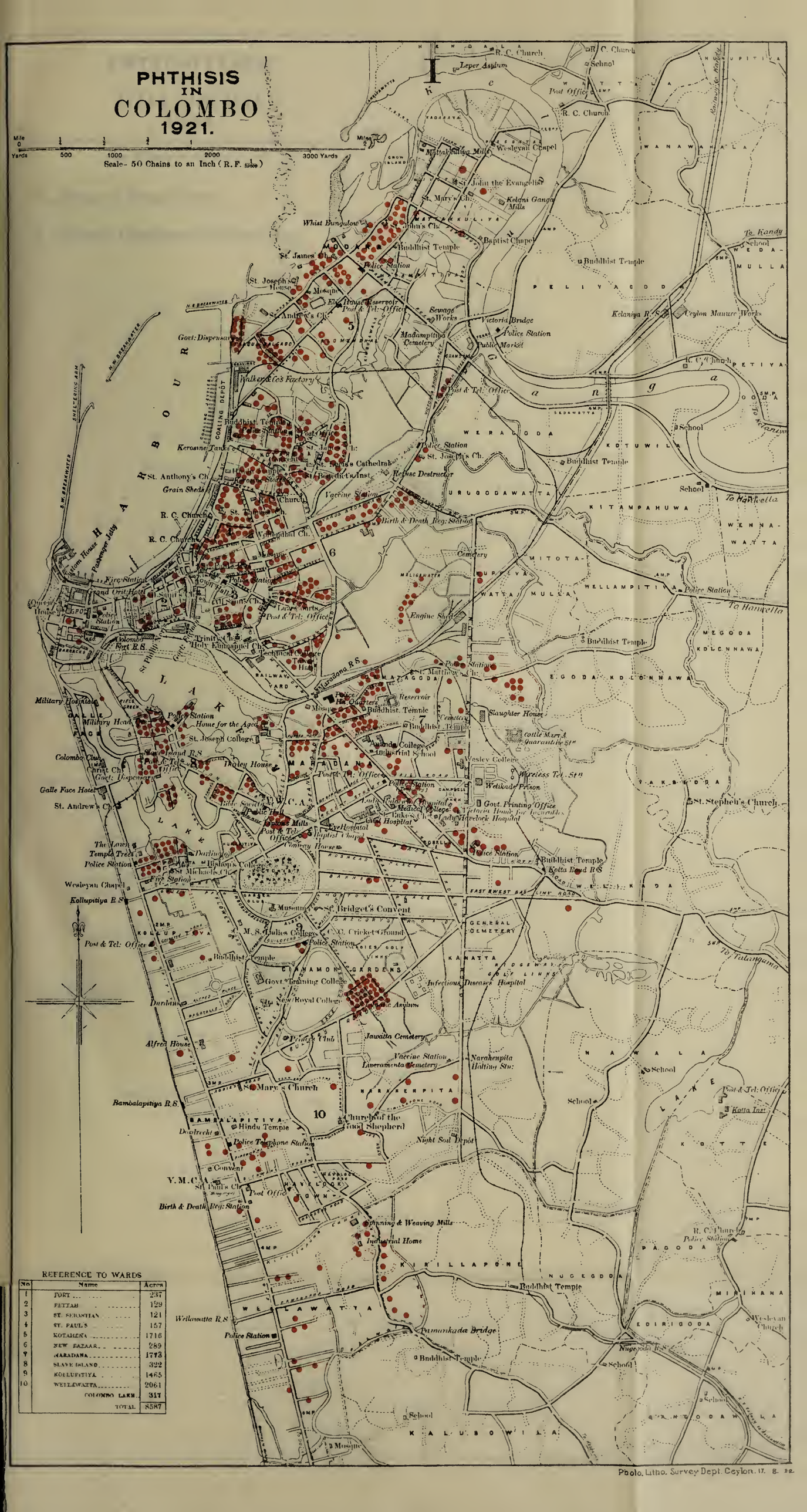
[*Note large amount of household effects turned out.*]

Photo IV.

FUMIGATION OF TENEMENTS AT MARADANA.

[*Note workmen on roof removing tiles to let in sunlight.*]

PHTHISIS IN COLOMBO 1921.



REFERENCE TO WARDS

No	Name	Acres
1	FORT	237
2	PETTAH	129
3	ST. SEBASTIAN	121
4	ST. PAUL'S	157
5	KOTAHENA	1716
6	NEW BAZAAR	289
7	MARADANA	1773
8	SLAVE ISLAND	322
9	KOLLUPITIYA	1465
10	WELLAWATTA	2061
	COLOMBO LAKE	317
	TOTAL	8587

Photo. Litho. Survey Dept. Ceylon. 17. 8. 22.


ENTERIC FEVER
IN
COLOMBO
1921.
Scale- 50 Chains to an Inch (R.F. 1/792)
....Enteric Fever Cases
....Simple Continued Fever Cases
REFERENCE TO WARDS
No | Name | Acres
1 | FORT | 237
2 | PETTAH | 129
3 | ST. SEBASTIAN | 121
4 | ST. PAUL'S | 157
5 | KOTAHENA | 1716
6 | NEW BAZAAR | 289
7 | MARADANA | 1773
8 | SLAVE ISLAND | 322
9 | KOLLUPITIYA | 1465
10 | WELLAWATTA | 2061
COLOMBO LAKE | 317
TOTAL | 8587
Photo. Litho. Survey Dept. Ceylon. 17. 8. 22


MALARIA IN 1921.
COLOMBO
Scale- 50 Chains to an Inch (R.F. 1/3960)
1921 Known Cases
1921 General Prevalence
1922 Cases.(Jan & Feb)
L A. Listoni
S A. Sinensis
T A. Tessalatus
J A. Jamesii
REFERENCE TO WARDS
No | Name | Acres
1 | FORT | 237
2 | PETTAH | 129
3 | ST. SEBASTIAN | 121
4 | ST. PAUL'S | 157
5 | KOTAHENA | 1716
6 | NEW BAZAAR | 289
7 | MARADANA | 1773
8 | SLAVE ISLAND | 322
9 | KOLLUPITIYA | 1465
10 | WELLAWATTA | 2061
COLOMBO LAKE | 317
TOTAL | 8587
Photo. Litho. Survey Dept. Ceylon. 19 8 22.

PLAGUE IN 1921.

COLOMBO

Scale- 60 Chains to an Inch (R.F. 1/7920)

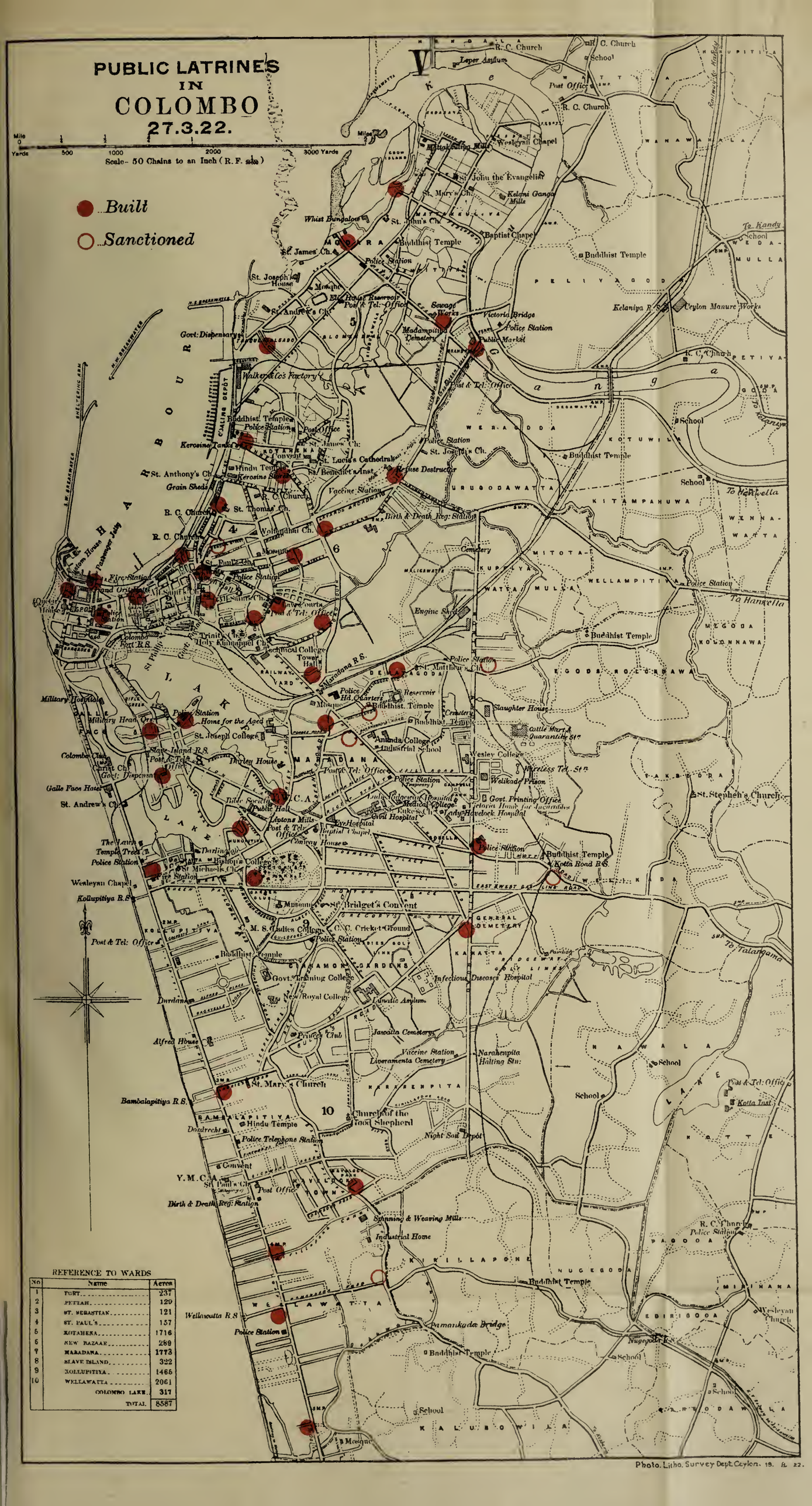
●...*Human Cases*

●...*Rat Cases*

REFERENCE TO WARDS

No	Name	Acres
1	FORT	237
2	PETTAH	129
3	ST. SEBASTIAN	121
4	ST. PAUL'S	137
5	KOTAHENA	1716
6	NEW BAZAAR	289
7	MARADANA	1773
8	SLAVE ISLAND	322
9	KOLLUPITIYA	1465
10	WELLAWATTA	2061
	COLOMBO LAKE	317
	TOTAL	8587

Photo. Litho. Survey Dept. Ceylon. 19. 8. 22.


PUBLIC LATRINES
IN
COLOMBO
27.3.22.
Scale- 50 Chains to an Inch (R. F. 1/3960)
Built
Sanctioned
REFERENCE TO WARDS
No | Name | Acres
1 | PORT | 237
2 | PETTAH | 120
3 | ST. SEBASTIAN | 121
4 | ST. PAUL'S | 157
5 | KOTAHENA | 1716
6 | NEW BAZAAR | 289
7 | MARADANA | 1773
8 | SLAVE ISLAND | 322
9 | KOLLUPITIYA | 1465
10 | WELLAWATTA | 2061
COLOMBO LAKE | 317
TOTAL | 8587
Photo. Litho. Survey Dept. Ceylon. 19. 8. 22.


SPECIAL AREAS
COLOMBO
Scale- 50 Chains to an Inch (R.F.)
A
B
C
D
E
RESOLUTION OF COUNCIL
6TH SEPTEMBER, 1921.
SEC. 27. ORD. 19 OF 1915.
F
ORDER OF CHAIRMAN
8TH MARCH, 1922.
SEC. 212 ORD. 6 OF 1910.
D. OFFENSIVE TRADES (BROWN)
SCHEDULE A
Plumbago Curing
Lime Burning
Brick Making
Tanning
Green Hides Stores
Manure Manufacture
Manure Stores
Green Bones Stores
Offal or Blood Boiling
Soap Making (Animal fats)
Oil Boiling (Animal fats)
F. SPECIAL AREA. (BLUE)
Copra
E. SPECIAL AREA (GREEN)
Plumbago Curing
Lime Burning
Brick Making
A.B.C. RESIDENTIAL AREA (RED)
Domestic Buildings
Public Buildings
Municipal Buildings
Tenements with
special Sanction
NOTE. In area F. COPRA Licenses are to be allowed freely whether within 50 feet of a dwelling or not. They are not allowed at all in areas A. B. or C. In area D. they are allowed without restriction. In all unreserved areas they are not allowed within 50 feet of a dwelling, bakery or eating house
REFERENCE TO WARDS
No | Name | Acres
1 | FORT | 237
2 | PETTAH | 129
3 | ST. SEBASTIAN | 121
4 | ST. PAUL'S | 157
5 | KOTAHENA | 1716
6 | NEW BAZAAR | 289
7 | MARADANA | 1773
8 | SLAVE ISLAND | 322
9 | KOLLUPITIYA | 1465
10 | WELLAWATTA | 2061
COLOMBO LAKE | 317
TOTAL | 8587